

EE 337: Microprocessors Laboratory (Spring 2024)

Indian Institute of Technology Bombay

Lab 6: 20 points

Date: February 14, 2023

In this lab, you will learn to use timers for tone generation.

- To learn about timers, refer the following document: 8051 Timers
 - To learn about interrupts, refer the following document: 8051 Interrupts
1. [5 points] Complete the Embedded C code at `lab6_1.c` to create unsymmetrical square wave at port P3.6 using timer 1 in polling mode. The square wave should have ON time 4 *ms* and OFF time 12 *ms*.
Observe the output using Keil Logic Analyzer first. Then upload the code on the Pt-51 board and use a Digital Storage Oscilloscope in lab to observe the output.
 2. [5 points] Complete the Embedded C code at `lab6_2.c` to generate two square waves simultaneously at P3.6 and P3.7 pins of time periods 2 *ms* and 3 *ms* using timer 0 and timer 1 in interrupt mode.
Observe the outputs using Keil Logic Analyzer first. Then upload the code on the Pt-51 board and use a Digital Storage Oscilloscope in lab to observe the outputs.
 3. [10 points] Musical notes can be generated using square wave-forms of some specific frequencies and can be heard using a speaker with appropriate interfacing. Write an Embedded C code to play notes corresponding to the frequencies given in Table 1. The order and duration of the notes are also mentioned.

Sl.No	Note	Frequency (<i>Hz</i>)	Duration (<i>ms</i>)
1	Sa (low)	240	500
2	Re	270	750
3	Ga	300	1000
4	Ma	320	500
5	Pa	360	1000
6	Dha	400	750
7	Ni	450	1000
8	Sa (high)	480	500

Table 1: Musical Notes Table

- i) Use timer T0 to generate the note (waveform) of appropriate frequency. Use timer T1 to control the duration of the note. The output has to be written to port pin P0.7. Verify the frequencies generated and the duration for which it is played in Keil and proceed to the next part.
- ii) Connect the speaker to the Pt-51 kit using the SL100 transistor and interfacing circuit shown in Figure 1. You should be able to hear the notes being played on the speaker.

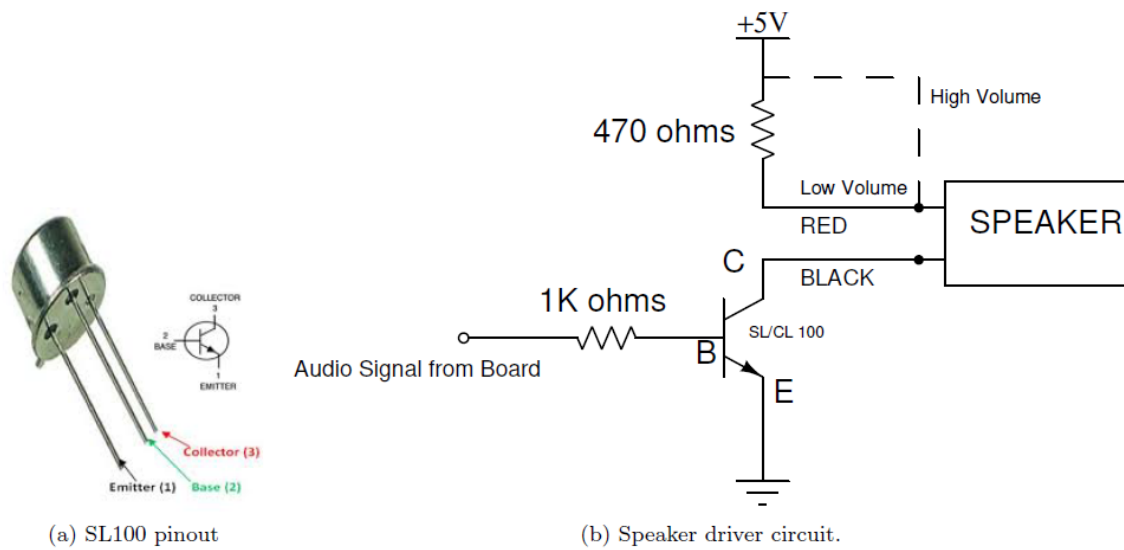


Figure 1: Circuit Diagram for Speaker Interface

TA Checkpoints

- 1 Check whether proper ON time and OFF time is obtained for the square wave in Logic Analyzer. Also, check whether the output in DSO is proper.
- 2 Check that TH, TL, TMOD are set properly to enabled interrupts for generating square waves simultaneously. Also, check whether the output in DSO is proper.
- 3
 - i) Check if the wave-forms of required frequencies are being generated for required duration in Logic Analyser.
 - ii) Check if the interfacing is working by observing the output from the speaker.