

In this lab, you will be learning to use the Pt-51 board as a musical instrument by interfacing it with keypad and speaker.

The main task is to learn about keypad interfacing i.e how to read the pressed key and then to use it to play the corresponding musical note (which you have done in Lab 6).

1. [20 points] The flow-chart in Figure 1 shows the algorithm to read from the keypad.

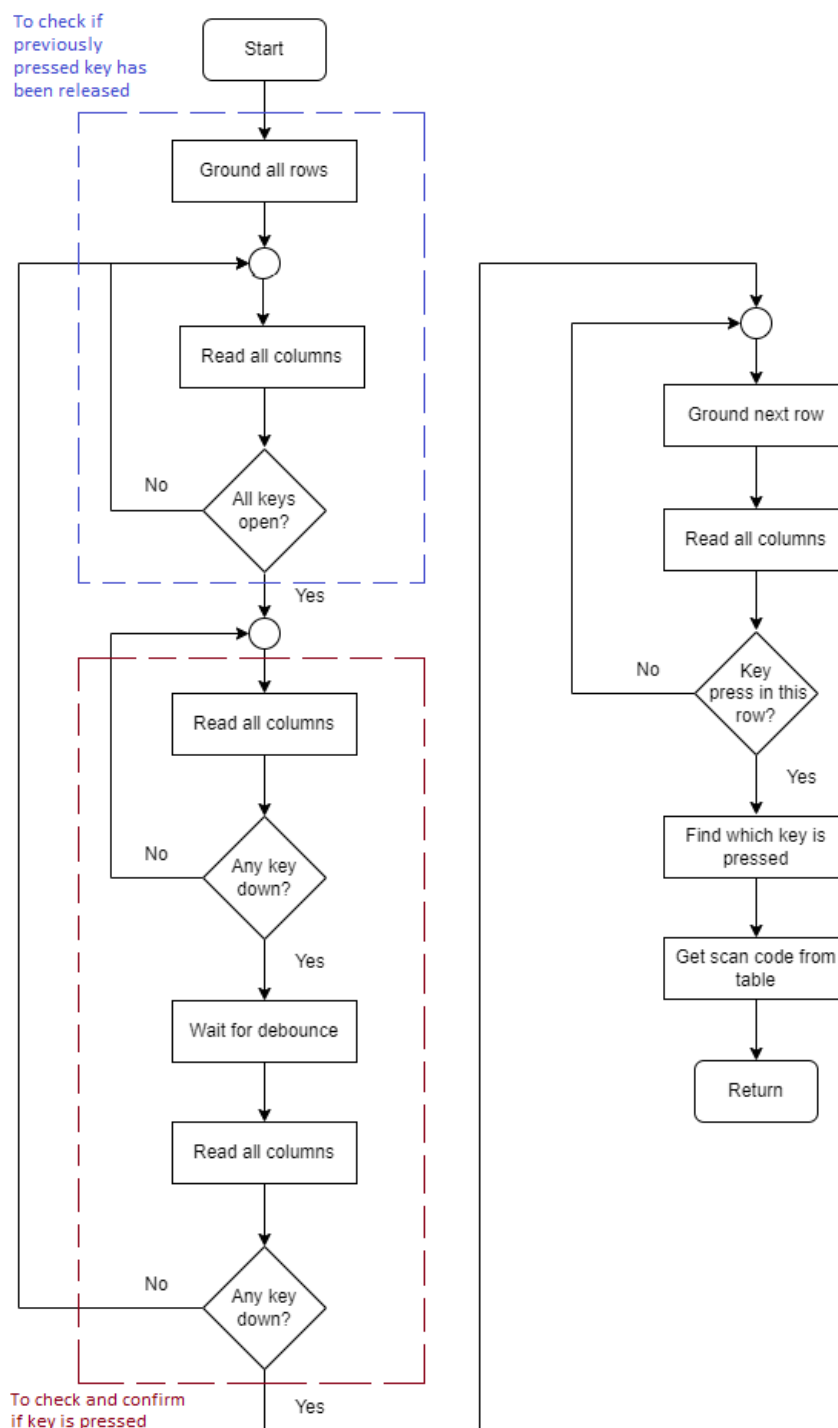


Figure 1: Flowchart describing procedure for reading keys

Note: Keep debounce delay of 20 ms.

The internal circuit diagram of the keypad is given Figure 2.

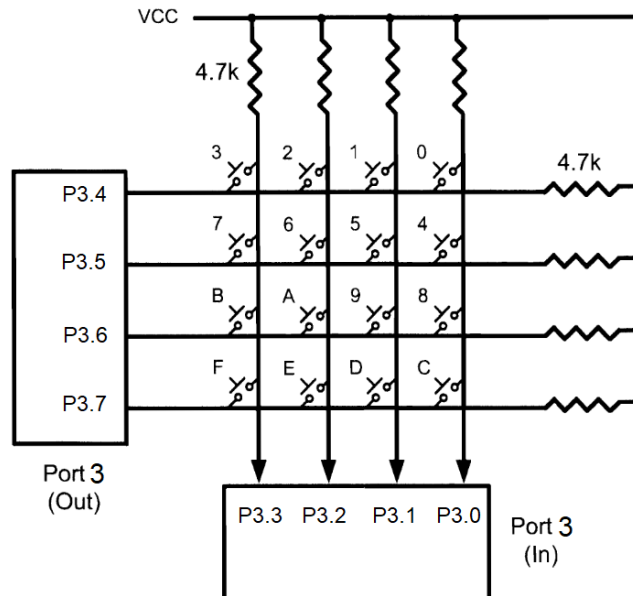


Figure 2: Keypad Circuit

Note that the rows are outputs and columns are inputs.

Refer the images in Figure 3 to understand the keypad.

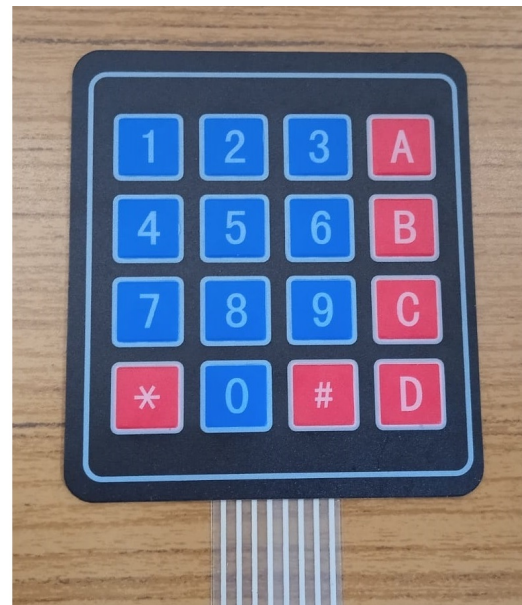
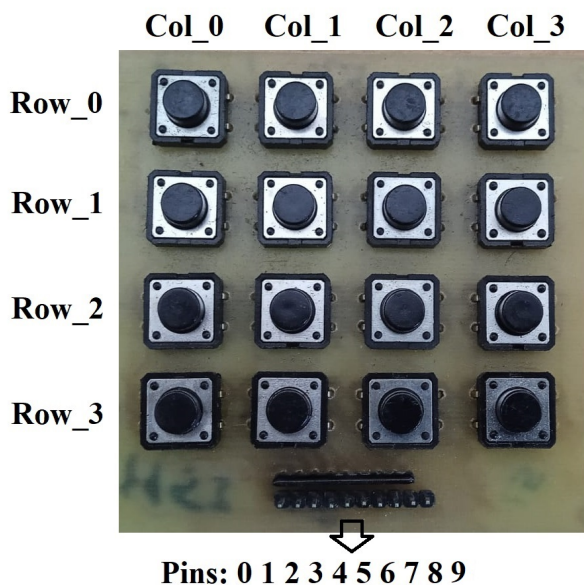


Figure 3: Keypad Mapping

The image on the right describes which key corresponds to which character. For example, the key at Row 0, Column 0 corresponds to the character '1'.

Refer to the Table 1 for pin mapping and Table 2 to see which musical note needs to be played for which key.

Pins	Mapping	Pt-51
Pin0	Row 3	P3.7
Pin1	Row 2	P3.6
Pin2	Row 1	P3.5
Pin3	Row 0	P3.4
Pin4	Column 0	P3.3
Pin5	Column 1	P3.2
Pin6	Column 2	P3.1
Pin7	Column 3	P3.0
Pin8	Pull-up resistance	5V on board
Pin9	Not connected	-

Table 1: Pin mapping

For 5V connect to the on board power supply pin near USB attach/detach switch.

Key	Note	Frequency (Hz)
1	Sa (low)	240
2	Re	270
3	Ga	300
4	Ma	320
5	Pa	360
6	Dha	400
7	Ni	450
8	Sa (high)	480
9	Silence	0

Table 2: Key to Musical Note Mapping

The remaining keys are not used in this application/task but feel free to add some functionalities to them, such as displaying some message on the LCD.

Task Guidelines-

- Your code must be running in an infinite loop. Every time a valid key is pressed, the corresponding musical note must be played on the speaker and its name must be displayed on the LCD until the valid key is pressed.
For example, if 1 is pressed (and properly read), the speaker should output a square waveform of 240 Hz frequency and the LCD should display “Sa”.
- Before trying on board with the keypad verify the correctness of the code by using debug session on Keil with breakpoints using I/O peripherals → Port3 to give inputs. **When a key is pressed, the output given to the row value gets reflected on the corresponding column value.**
- For verifying that all the keys in the keypad are working, you can use the hex file provided, Keypad.hex.

Note:

This is a 2 week experiment. You can try only the key-pad interface in the first week and then move on to speaker and LCD outputs after key-pad function is verified (just a recommendation, you can follow your own strategy).

TA Checkpoints

- Check if keys are being detected properly and the corresponding musical notes are being played on the speaker.
- Check if the LCD correctly displays the name of the musical note being played.