

TECH 4234

Lab #2

PS2 Keyboard - Synchronous Serial Communications

In this experiment we will use Synchronous Serial communications to read a PS2 keyboard using an Arduino.

Background¹:

The PC/AT keyboard transmits data in a clocked serial format consisting of a start bit, 8 data bits (LSB first), an odd parity bit and a stop bit. The clock signal is only active during data transmit. The generated clock frequency is usually in the range 10 - 30 kHz. Each bit should be read on the falling edge of the clock.

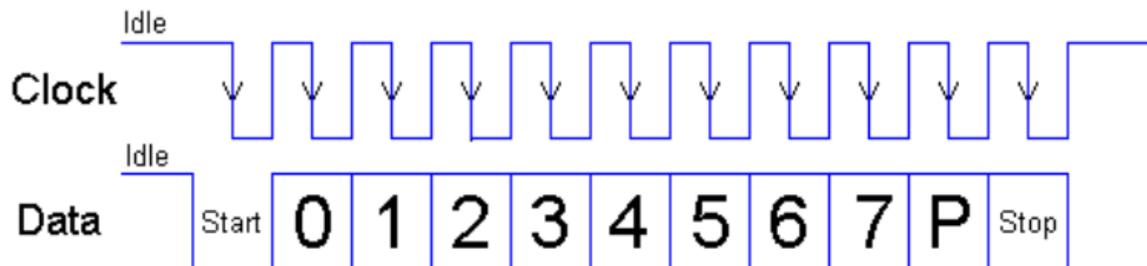


Figure 1- Keyboard Transmission Waveform

The above waveform represents a one byte transmission from the keyboard. The keyboard generally changes its data line on the rising edge of the clock as shown in the diagram. The data line only has to be valid on the falling edge of the keyboard clock. The Least Significant Bit is always sent first.

When a key is pressed, the keyboard transmits a 'make' code consisting of an 8-bit 'scan' code denoting the key pressed and, when the key is released, a 'break' code. The 'break' code (key released) consists of the same 8-bit scan code preceded by a special code - 'F0'H.

The keyboard handles combinations with control keys as SHIFT, CTRL, ALT, etc as two separate key presses, i.e., SHIFT-MAKE, 'A'-MAKE, SHIFT-BREAK, 'A'-BREAK. The 'A' scan code ('1C'H) is the same for both the shifted and unshifted state. To determine whether the 'A' scan code is interpreted as 'A' or 'a', the PC must keep track of the presence or absence of a prior SHIFT-MAKE.

¹ http://www.isy.liu.se/en/edu/kurs/TSTE12/laboration/TSTE12_Lab1_170824.pdf

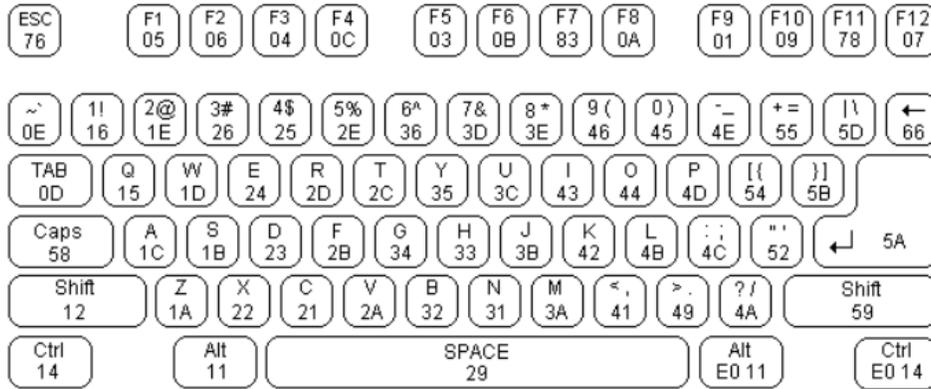


Figure 2- Scan Codes

| Key | Make | Break |
|-----|-------|-------------|
| A | '1C'h | 'F0'h '1C'h |
| B | '32'h | 'F0'h '32'h |
| C | '21'h | 'F0'h '21'h |
| D | '23'h | 'F0'h '23'h |
| E | '24'h | 'F0'h '24'h |
| F | '2B'h | 'F0'h '2B'h |

Figure 3 - Scan Code Examples

The Keyboard's uses a standardPS2 connection as shown below. You will be provided a breakout board with +5v, GND, DAT, and CLK marked on the pins.

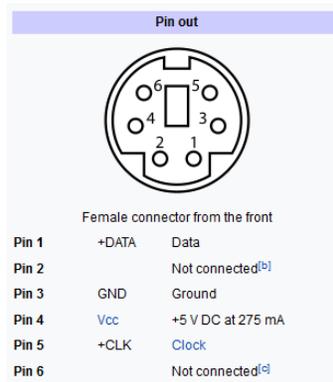


Figure 4- PS2 connection²

² https://en.wikipedia.org/wiki/PS/2_port

Lab Assignment:

Using INT0 for the CLOCK and Pin PD4 for the data lines. Write a program that will take in the keyboard signal and display the scan codes for each key pressed as well as the character they represent. You can use the array (shown below) to convert the value received in data bits 7..0 as the array element number³.

```
unsigned char LC_Array[] =
{0x0,0x0,0x0,0x0,0x0,0x0,0x0,0x0,0x0,0x0,0x0,0x0,0x0,0x0B,0
x60,0x0,0x0,0x0,0x0,0x0,0x0,0x71,0x31,0x0,0x0,0x0,0x7A,0x73
,0x61,0x77,0x32,0x0,0x0,0x63,0x78,0x64,0x65,0x34,0x33,0x0,0
x0,0x20,0x76,0x66,0x74,0x72,0x35,0x0,0x0,0x6E,0x62,0x68,0x6
7,0x79,0x36,0x0,0x0,0x0,0x6D,0x6A,0x75,0x37,0x38,0x0,0x0,0x
2C,0x6B,0x69,0x6F,0x30,0x39,0x0,0x0,0x2E,0x2F,0x6C,0x3B,0x7
0,0x2D,0x0,0x0,0x0,0x27,0x0,0x5B,0x3D,0x0,0x0,0x0,0x0,0x0A,
0x5D,0x0,0x5C,0x0,0x0,0x0,0x0,0x0,0x0,0x0,0x0,0x8,0x0,0x0,0
x0,0x0,0x0,0x0,0x0,0x0,0x0,0x0,0x0,0x0,0x0,0x0,0x0,0x1B,0x0
,0x0,0x0,0x0,0x0,0x0,0x0,0x0};
```

Issues to resolve:

1. Since the bits come in in LSB to MSB order, you will have to reverse the bit order. You can use a technique of shifting the bits to the right and then adding the new bit to the MSB (+128 or +0 for a 1 or a zero respectively)
2. You must skip a bit the first falling edge of the clock (see Figure 1)
3. You must skip the last two bits (parity and stop bits) as well (again refer to Figure 1)

A suggested output would be the hex value followed by the character (from the given array). Here is a sample of the suggested output (in the example, 'abc' was typed):

```
1c      a
f0
1c      a
32      b
f0
32      b
21      c
f0
21      c
```

Note: it is expected to show the scan code, break code and scan code as shown above. You are also not required to do any special processing for caps, control or alt keys.

Submit the zipped project via the online file submission system. Due in one week.

³ Thanks to user_17961008 on <https://community.cypress.com/thread/33307>