# TECH 3812
# Lab #3
# PS2 Keyboard - Synchronous Serial Communications

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

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**Background**[1]:

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.
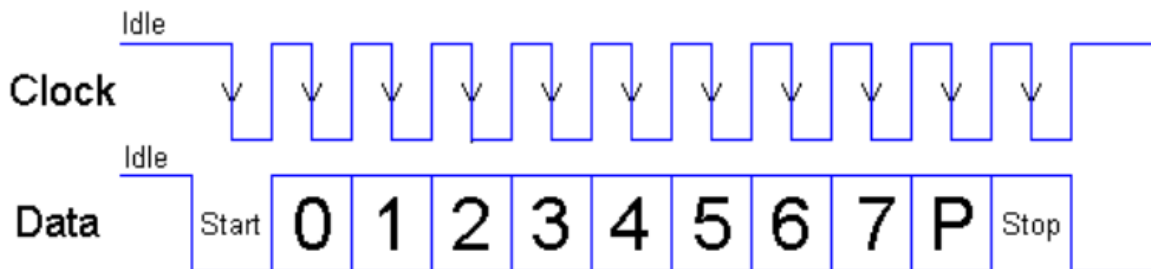


*Figure 1- Keyboard Transmission Waveform*

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.

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[1] http://www.isy.liu.se/en/edu/kurs/TSTE12/laboration/TSTE12_Lab1_170824.pdf
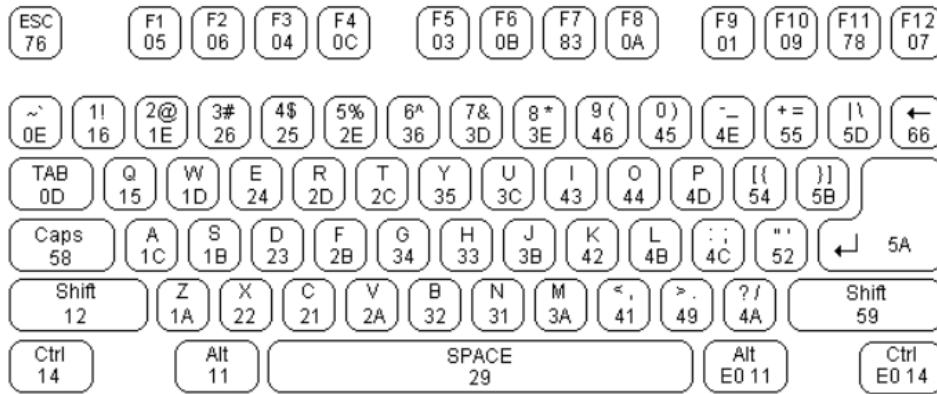
*Figure 2- Scan Codes*

| Key | Make | Break |
|-----|------|-------|
| Z | 0x1A | 0xF0 then 0x1A |
| X | 0x22 | 0xF0 then 0x22 |

*Figure 3 - Scan Code Examples*

The Keyboard's uses a standard PS2 connection as shown below. You will be provided a breakout board with +5v, GND, DAT, and CLK marked on the pins.
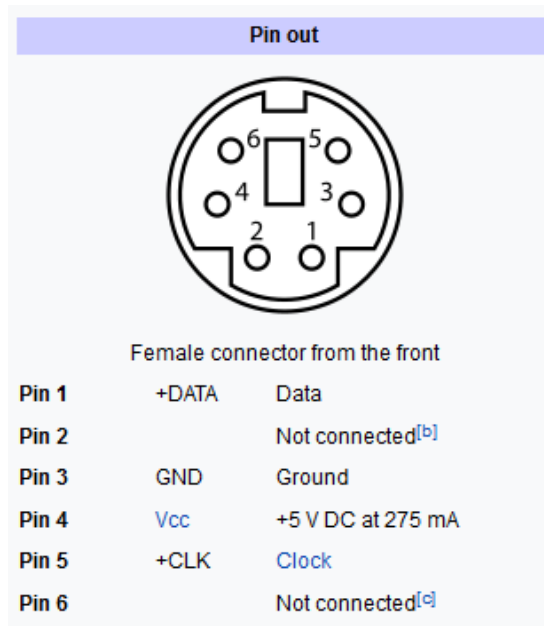


**Pin out**

Female connector from the front

| Pin 1 | +DATA | Data |
| Pin 2 | | Not connected[b] |
| Pin 3 | GND | Ground |
| Pin 4 | Vcc | +5 V DC at 275 mA |
| Pin 5 | +CLK | Clock |
| Pin 6 | | Not connected[c] |

*Figure 4- PS2 connection[2]*

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

**Lab Assignment:**

Connect a PS2 Keyboard to a power supply (+5v and Gnd) and to an Oscilloscope (Ch1 to Clock, Ch2 to Data and at least one ground).

Capture the waveform for the MAKE signal for your first and last initial of your name. You will need to properly trigger the scope to start the capture of a SINGLE waveform at the first falling edge of the clock. Make sure the image shows all the bits of the MAKE signal. Please capture the waveform with INVERT turned on (so the image has a white, not black, background).

**Analysis:**

1. Using the waveforms captured, analyze the waveform (making each active edge of the clock and its corresponding data. Show that the waveform captured is that of the keys pressed for your initials. Also indicate the parity bit shown and prove that the parity bit is correct for the letter pressed.
2. Calculate the clock frequency of the keyboard and baud rate of the data transmission. Show your calculations for full credit.

Submit the analyzed waveforms (2x) as well as the calculated clock frequency and baud rate.