

# Design and Simulate Transistor-Based PS/2 Interface using eSim

## Introduction:

The PS/2 protocol is a serial communication standard designed initially for keyboard and mouse interfaces. The protocol is realized using two dedicated communication links- a clock line and a serial data line employing the open- collector/open-drain bus scheme. Although the majority of PS/2 interfaces use specialized microcontrollers or transceivers ICs, this design shows how such protocol can be implemented physically at transistor level using eSim software and common NPN BJTs.

The circuit consists of a cross-coupled autonomous astable multivibrator to create a clock, an open collector data link with RC cable simulation and two cascaded RTL buffers.

## Simulation Diagram:

The schematic diagram of the Transistor-Based PS/2 Interface is shown below:

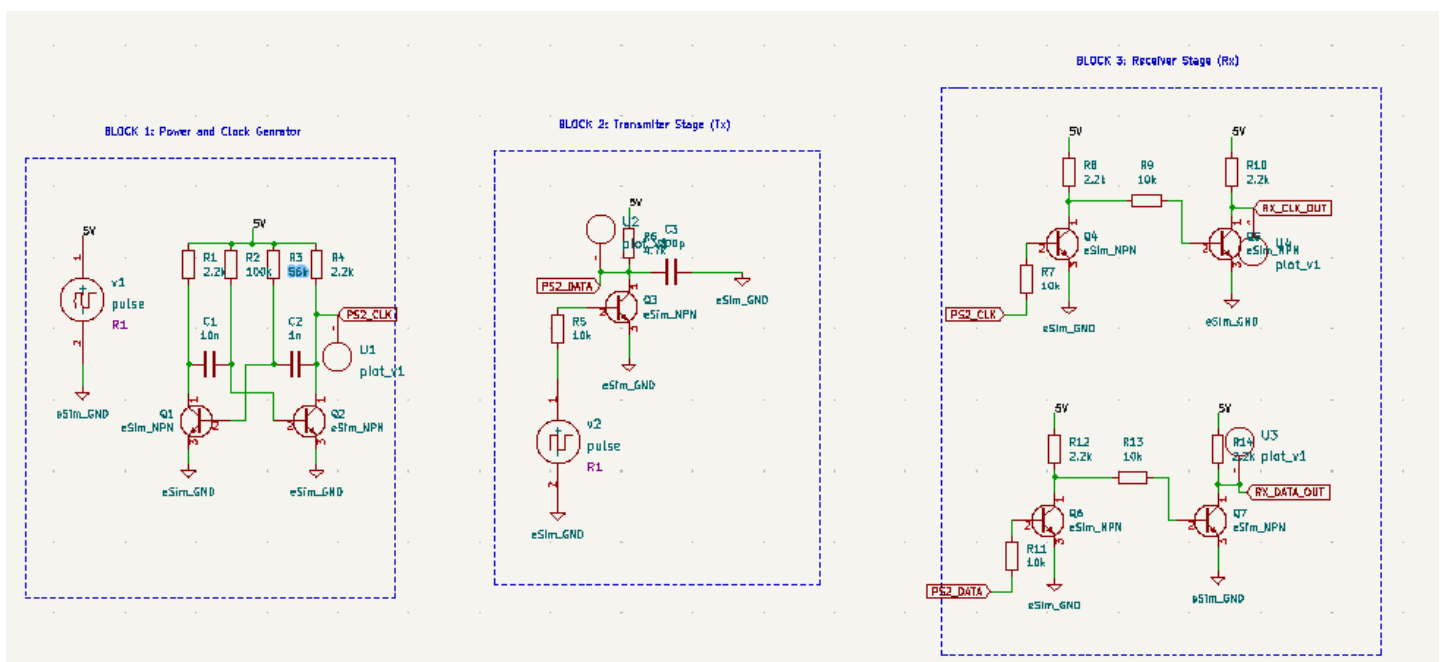
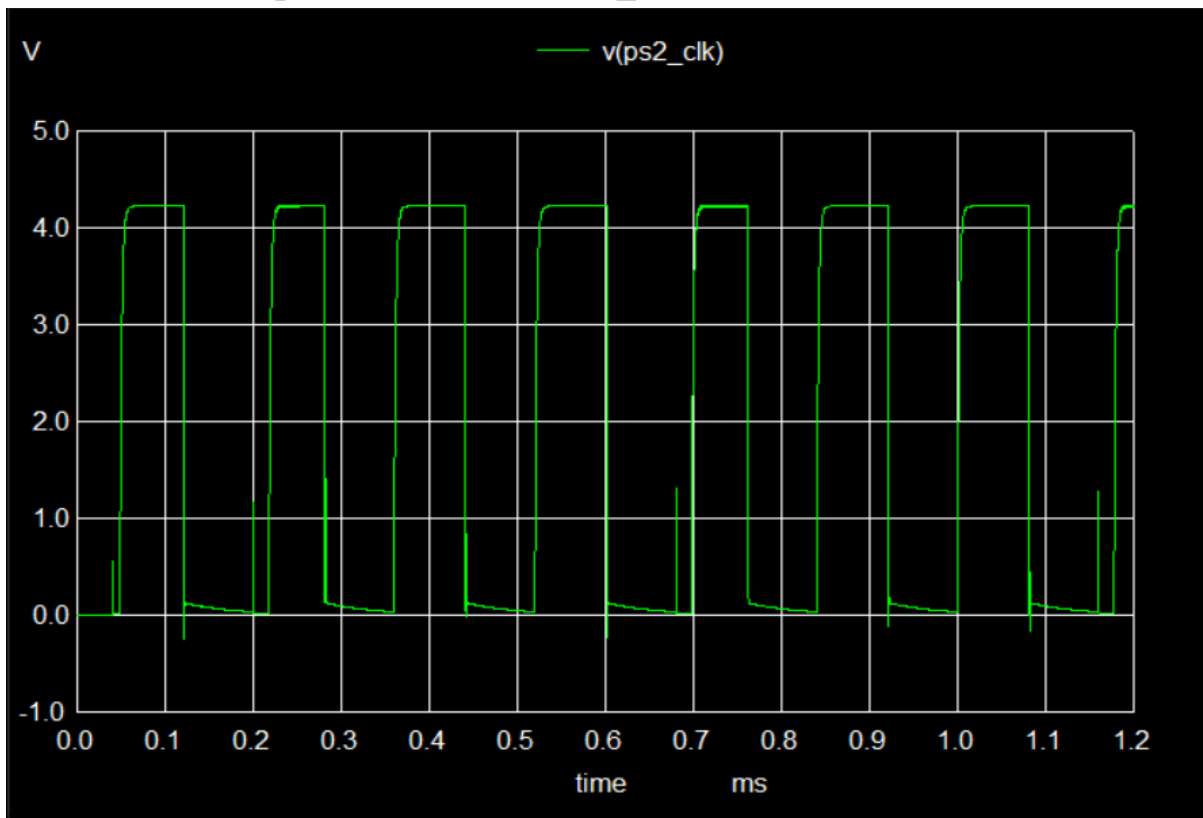


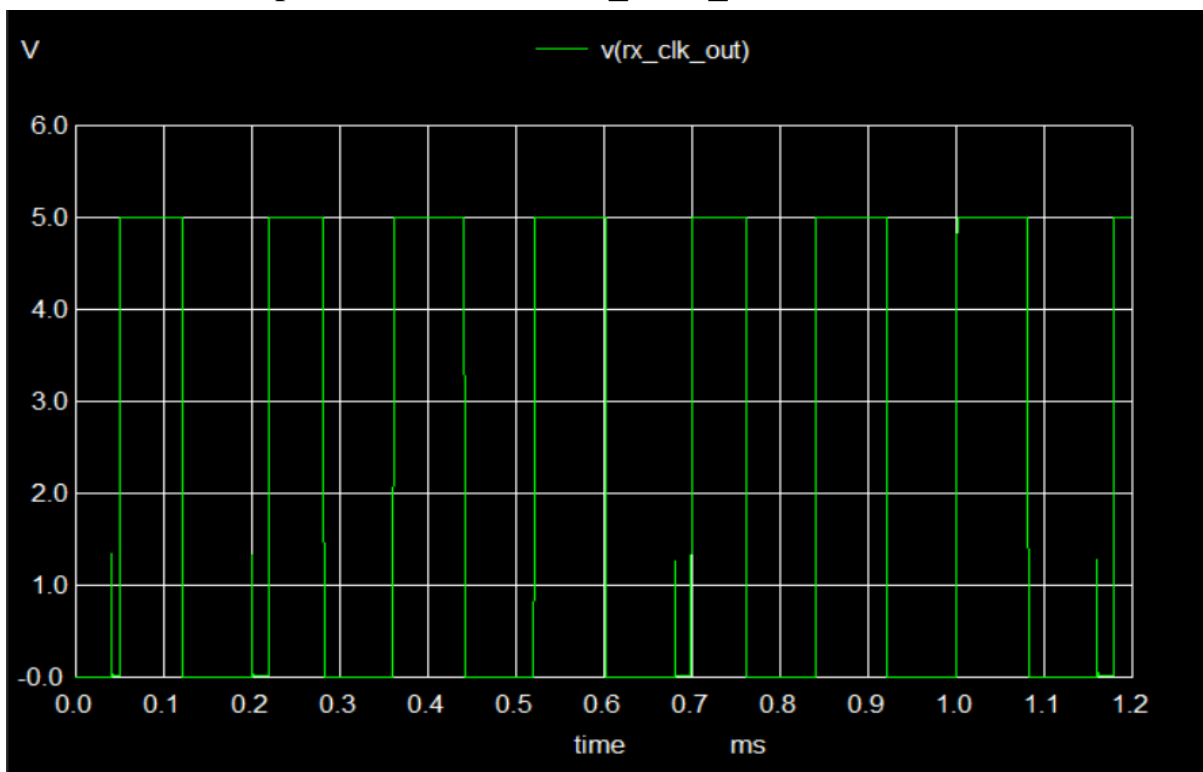
Fig.1 Transistor-Based PS/2 Interface in eSim schematic

### NGSPICE Output Waveform at PS2\_CLK Terminal:



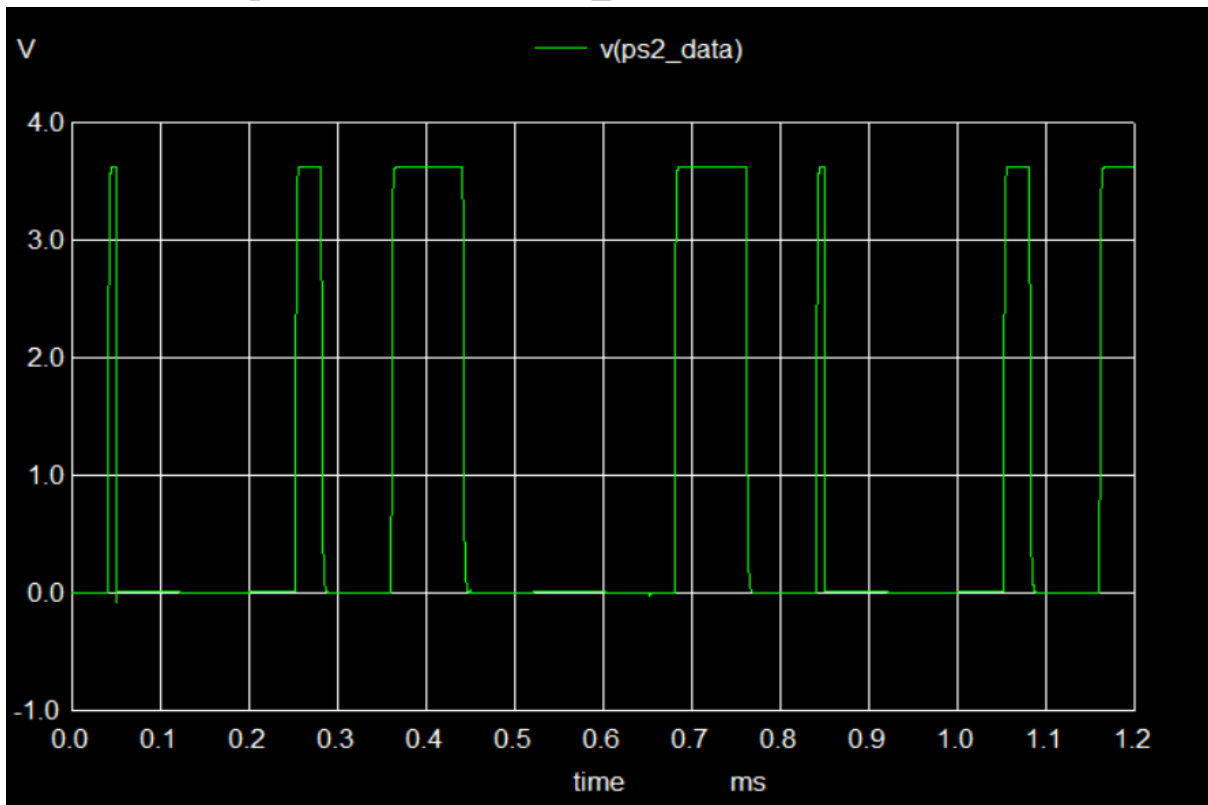
*Fig.2 NGSPICE Output Waveform at PS2\_CLK terminal of PS/2 Interface*

### NGSPICE Output Waveform at RX\_CLK\_OUT Terminal:



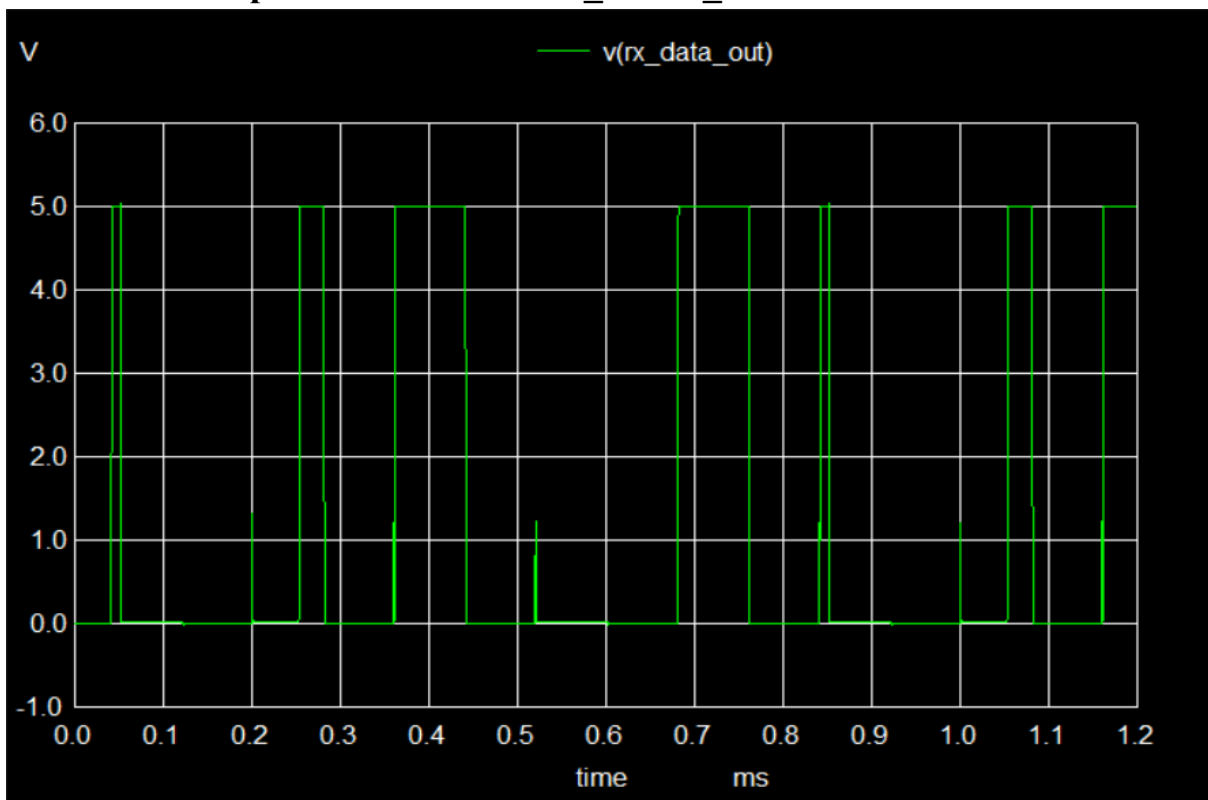
*Fig.3 NGSPICE Output Waveform at RX\_CLK\_OUT terminal of PS/2 Interface*

### NGSPICE Output Waveform at PS2\_DATA Terminal



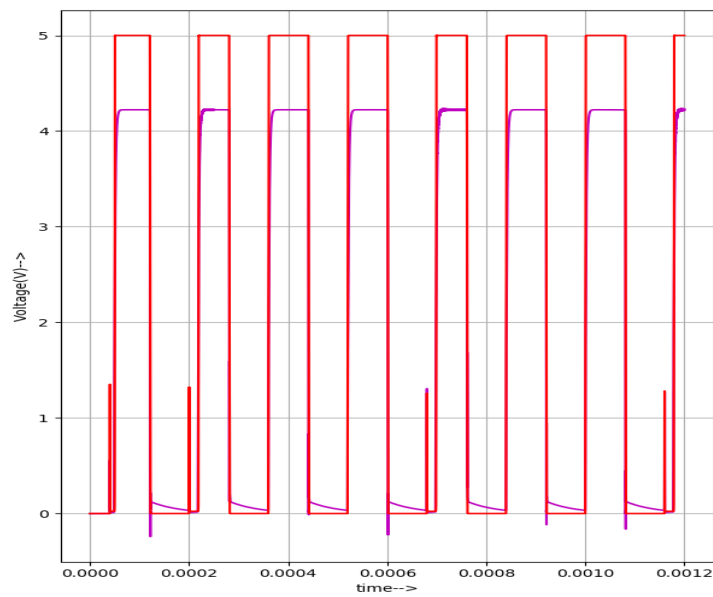
*Fig.4 NGSPICE Output Waveform at PS2\_DATA Terminal of PS/2 Interface*

### NGSPICE Output Waveform at RX\_DATA\_OUT Terminal:



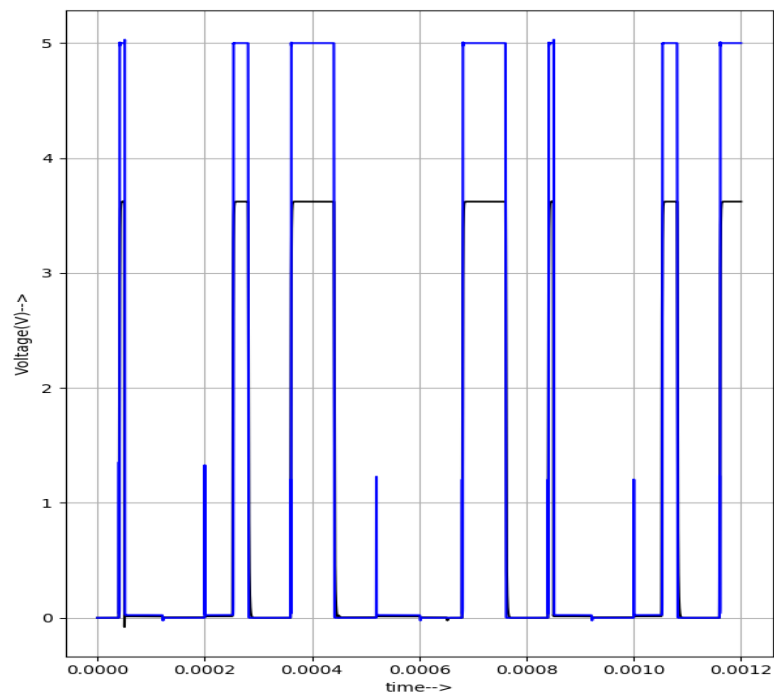
*Fig.5 NGSPICE Output Waveform at RX\_DATA\_OUT terminal of PS/2 Interface*

## Python Plot at Clock Generator:



*Fig.6 Python Plot of Clock Generator Output and receiver Output*

## Python Plot at DATA Line:



*Fig.7 Python Plot of PS/2 Data Line and Restored Output*

## **Conclusion:**

In conclusion, the design and simulation of a transistor-based PS/2 interface in eSim have been successfully carried out and waveforms have been captured using the eSim software. An astable multivibrator produced a reliable clock signal, an open-collector driver has reliably controlled the data bus when loaded with a capacitive cable and the RTL receiver buffers reliably captured the rail-to-rail 0 to 5V digital waveforms.

## **References:**

- Wikipedia, "Multivibrator": <https://en.wikipedia.org/wiki/Multivibrator>.
- University of Toronto ECE, "The PS/2 Mouse/Keyboard Protocol": [https://wwwug.eecg.utoronto.ca/desl/nios\\_devices\\_SoC/datasheets/PS2%20Protocol.htm](https://wwwug.eecg.utoronto.ca/desl/nios_devices_SoC/datasheets/PS2%20Protocol.htm).
- Wikipedia, "PS/2 Port": [https://en.wikipedia.org/wiki/PS/2\\_port](https://en.wikipedia.org/wiki/PS/2_port).

## **Project Submitted By:**

Mr. Madhvesh Kapadia  
School of Electronics and Electrical Engineering  
VIT Bhopal University, Sehore, Madhya Pradesh, India.