The PS/2 Keyboard and Mouse Interface

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The IBM PC Keyboard

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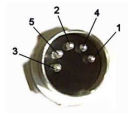
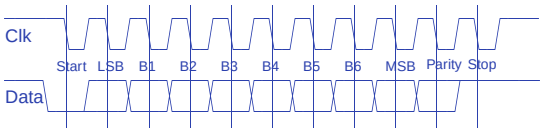
Original keyboard connector: DIN-5



The PS/2 Mini-DIN 6 Connector

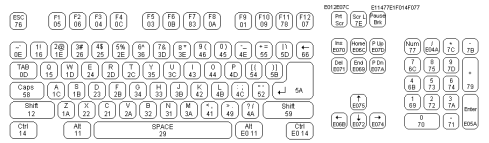
Female Socket

Synchronous Serial Interface



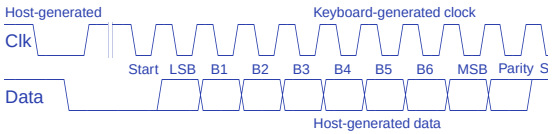
Like RS-232, but with a clock.
Odd parity, one start, one stop.
Keyboard-to-host shown: keyboard initiates everything.

Codes (Keyboard to Host)



- 00/FF Error or buffer overflow
- F0 Key-up
- FA Acknowledge
- EE Echo response
- FE Resend
- E0 Extended code coming

Communicating to the Keyboard



Host brings Clock low, then Data low to indicate transfer to keyboard, then releases Clock (rises).

Keyboard starts generating clock signals. Host supplies serial data, changing after each falling edge. After stop bit, host releases Data.
Keyboard pulls Data low for one more clock

Commands (Host to Keyboard)

ED LED control

						Caps lock	Num lock	Scroll lock

EE Echo
Keyboard will respond with EE

F0 Set scan code set
Keyboard will respond with FA and wait for another byte 01–03. 00 leaves scan code unchanged.

F3 Set key repeat rate
Keyboard responds with FA and waits for second byte, indicating repeat rate.

Commands (Host to Keyboard)

F4 Enable keyboard
Responds with FA, clears buffer, enables scanning.

F5 Disable keyboard
Responds with FA, disables keyboard.

FE Resend
Retransmit the last byte.

FF Reset Keyboard

PS/2 Mouse Protocol

Three bytes sent every time mouse moves or button clicked:

MSB LSB

Y Overflow	X	Y Sign	X	1	Middle	Right	Left
					Buttons		
X movement							
Y movement							

Movement values are since last transmission: 9-bit two's-complement (signed) numbers.

Many more variants, modes, and other junk.

Using the PS/2 Port w/ Digilent Bd.

Add lines in the .UCF file about PS2C and PS2D:

```
NET "PS2D" LOC=m15;  # Data
NET "PS2C" LOC=m16;  # Clock
```

Add these ports in the "add cores" dialog. Make the clock pin a falling-edge-sensitive interrupt.

In the .MHS file, this appears as

```
 PORT PS2D = ps2io_GPIO_in, DIR = IN
 PORT PS2C = PS2C, DIR = IN,
    SIGIS = INTERRUPT,
    SENSITIVITY = EDGE_FALLING
```


Using the PS/2 Port w/ Digilent Bd.

Add an instance of an "opb_gpio." Connect it to the OPB bus. Configure it to be a single-bit input and connect GPIO_in to the data line.

In the .MHS file:

```
BEGIN opb_gpio
 PARAMETER INSTANCE = ps2io
 PARAMETER HW_VER = 3.01.a
 PARAMETER C_BASEADDR = 0x80200e00
 PARAMETER C_HIGHADDR = 0x80200fff
 PARAMETER C_ALL_INPUTS = 1
 PARAMETER C_GPIO_WIDTH = 1
 PARAMETER C_IS_BIDIR = 0
 BUS_INTERFACE SOPB = mb_opb
 PORT OPB_Clk = sys_clk_s
 PORT GPIO_in = ps2io_GPIO_in
END
```


Using the PS/2 Port w/ Digilent Bd.

Add the PS/2 Clock signal to the list of interrupts handled by the opb_intc (add cores dialog). In the .MHS:

```
BEGIN opb_intc
 PARAMETER INSTANCE = opb_intc_0
 PARAMETER HW_VER = 1.00.c
 PARAMETER C_BASEADDR = 0x80200100
 PARAMETER C_HIGHADDR = 0x802001ff
 BUS_INTERFACE SOPB = mb_opb
 PORT Irq = Interrupt
 PORT Intr = PS2C & RS232_Interrupt
END
```


Using the PS/2 Port w/ Digilent Bd.

This makes a keyboard-to-host port. Interrupt signals a clock. Do the shift register in software.

Register the handler and enable interrupts:

```
microblaze_enable_interrupts();

XIntc_RegisterHandler(
  XPAR_OPB_INTC_0_BASEADDR,
  XPAR_OPB_INTC_0_SYSTEM_PS2C_INTR,
  (XInterruptHandler)ps2_int_handler,
  (void *)0 );

XIntc_mMasterEnable(XPAR_OPB_INTC_0_BASEADDR);

XIntc_mEnableIntr(
  XPAR_OPB_INTC_0_BASEADDR,
  XPAR_RS232_INTERRUPT_MASK |
  XPAR_SYSTEM_PS2C_MASK);
```


Interrupt Handler

```
#define SIZE 16
unsigned char buffer[SIZE];
int head = 0; int tail = 0;

unsigned int code = 0; unsigned int bit = 11;

void ps2_int_handler(void *baseaddr_p) {
  int next;
  code = (code >> 1) |
      (XGpio_mReadReg(XPAR_PS2IO_BASEADDR,
                      XGPIO_DATA_OFFSET) << 9);
  if (--bit == 0) {
    next = (head + 1) & (SIZE - 1);
    if (next != tail) {
      buffer[head] = code;
      head = next;
    }
    bit = 11; code = 0;
  }
  XGpio_mWriteReg(  /* Acknowledge interrupt */
    XPAR_PS2IO_BASEADDR, XGPIO_ISR_OFFSET, 1);
}
```


Buffer Management Routines

```
int character_available()
{
  int result;
  microblaze_disable_interrupts();
  result = (head != tail);
  microblaze_enable_interrupts();
  return result;
}

unsigned char get_character()
{
  unsigned char result;
  microblaze_disable_interrupts();
  result = buffer[tail];
  tail = (tail + 1) & (SIZE - 1);
  microblaze_enable_interrupts();
  return result;
}
```