

## NeXT keyboard bus

NeXT computer's non-adb bus hardware has been an annoyance for sometime to everyone whom is without documentation. This makes everyone. I dedicate this work to [Dan Moore's](#) pile of NeXTStations; thanks again for the NeXT to probe. **Disclaimer:** I can guarantee none of this information to be correct. These are my initial findings (as of 16 DEC 2003), and I won't bother to update this again until my playing is complete. It only took me a day of playing to be able to use the keyboard to send signals to my Mac via my USB board. I've also gotten the NeXT to accept emulated keyboard codes.

### Hardware Overview

A serial signal of a partially unknown protocol comes from the NeXT and returns to the NeXT. The board has some OP-AMPS for the MIC input and DAC. The board also has a regulator which yields +5V for the keyboard/mouse combination. The serial signals are all a +5V potential from GND. The serial signal enters a custom ASIC made by Motorola (XC38LG002PR01 made in the 13th week of 1990).

Attached to this custom ASIC are the following:

keyboard port (In/Out)

MC145503DW (In, microphone PCM encoding)

SAA7320GP (Out, DAC which uses the I2S serial bus)

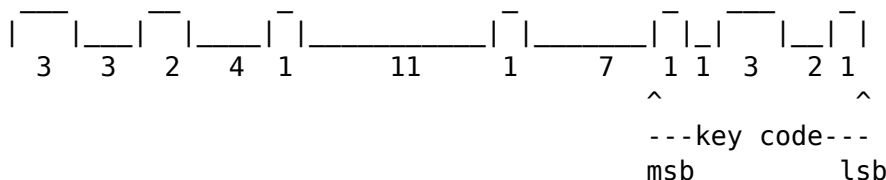
PS3739 (mystery NeXT ASIC)

### Monitor Bus Overview

The monitor bus connects the either the monitor or the sound-box to the NeXTStation. This bus includes +12V and -12V The serial clock for this bus is 20Mhz. The data signal potential is +5V.

#### Input Bus: Key-codes

The incoming signal contains the key presses, mouse and microphone data. This bus idles at zero volts unless there is data to send. It appears that a packet format exists with control bits followed by data. I'll describe this in detail when I have worked out all of the bits. The following signal is for a key-press of "a" with no other data. The timing value of each "\_" ASCII character is 200nS, ignore the "|" character. Due to the nature of ASCII art, I've put the unit count below the ticks. (3 == 600ns) (I initially thought that the complete packet takes 40 units, or 8uS, but there seems to be extra bits occasionally. More on this quandary later.)



The last 8-bits are the key-code. I believe the msb to be a marker-bit of sorts, because if you drop it you get the expected key code. Here is a partial list of key encodings. One can extrapolate the rest by looking at the key encoding vectors.

"a" 10111001 0xB9 (0x39)(see above timing example)  
 "s" 10111010 0xBA (0x3A)  
 "d" 10111011 0xBB (0x3B)  
 "f" 10111100 0xBC (0x3C)

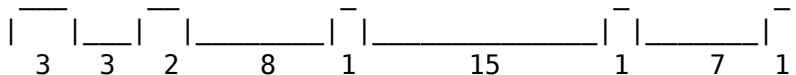
One should note that the key-codes which I determined correlate exactly to the key-map from the NeXTStep 3.3 developer documentation if the msb is indeed a marker-bit. (graphic below from channelu.com)



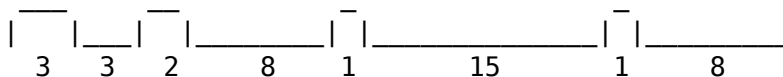
#### Input Bus: Mouse

First, you must be aware that I have a spectacularly broken mouse. Only the left mouse button, and the vertical vectoring work; however, I still acquired useful information from the mouse. I initially thought this would be fine, but I couldn't even short the switch into functionality; so it goes. Again, the timing value of each "\_" character is 200nS.

Mouse up:



Mouse down:

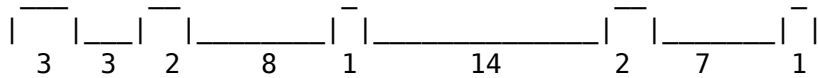


Scroll up:



3 3 2 8 1 7 8 7 1

Scroll down:



**Input Bus:** Microphone  
Not yet finished.

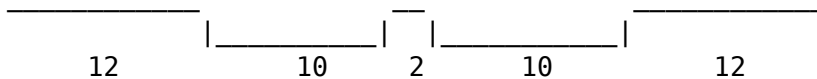
## Keyboard Bus Overview

The keyboard bus consists of 5 wires: GND, +5V, power on, serial in, serial out. The keyboard bus is odd because it doesn't have a clock, so I'm assuming that it's internal. The smallest significant unit of time seems to put the clock at 10Khz. The keyboard contains one Motorola S38DC007PP01, and some de-bounce circuitry so you don't blow it up when you plug in the mouse. The input and output serial lines are always active with repeated packet activity.

### Output Bus: Idle State

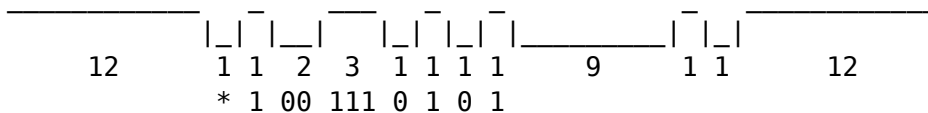
The output bus has a steady, repeating signal which I believe to be an empty packet. I'm confident that this is the carrier for the I2S data for the DAC. Especially because there's 125uS in total for the packet. Again, the timing below is 200nS for each " \_".

The timing value of each " \_" ASCII character is 50uS, ignore the "I" character.  
Output Idle Signal:



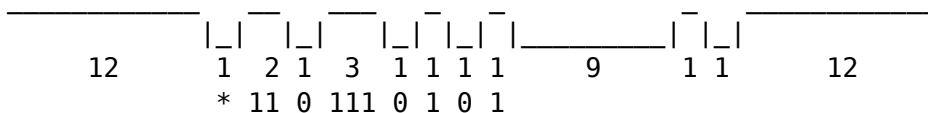
Unlike the monitor bus, bits are placed on the bus lsb first. For example, the key coding for "a" is 0x39, which follows below. "\*" denotes a start/stop bit.

0x39 "a":



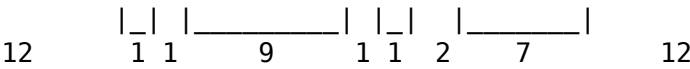
If you turn around binary 10011101, you get 10111001, which is 0xB9; drop the MSB, you get 0x39 which is our key board "a".

0x3B "d":

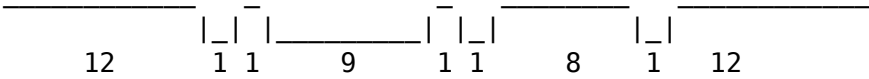


Scroll up:

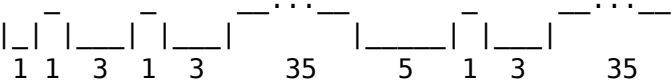




Scroll down:



The keyboard input signal is composed to two alternating signal forms. Again, the timing value of each "\_" ASCII character is 50uS.  
Input Idle Signal:



If you have any questions, please feel free to email me at "deg/s at the domain of 68k with a dot and an org".

