Using the NS32381 FPU in an NS32081 Socket

INTRODUCTION

The NS32381 is a second generation, CMOS, floating point slave processor that is fully software compatible with its forerunner, the NS32081 FPU. The NS32381 FPU functions with any CPU in the Embedded Systems Processors family, from the NS32008 to the NS32GX32. The performance of the NS32381 has been increased over the NS32081 by architecture improvements, hardware enhancements and higher clock frequencies. Key improvements include the addition of a 32-bit slave protocol, an early done algorithm that increases CPU/FPU parallelism, an expanded register set, an automatic power down feature, expanded math hardware and additional instructions.

This applications brief describes the design of an NS32381 daughter board that simplifies the upgrade of an existing NS32081 application to the NS32381 FPU. The daughter board plugs into the existing NS32081 socket, making it unnecessary to lay out a completely new board when upgrading FPUs. This brief also describes the hardware and software considerations as well as the performance benefits of interfacing the NS32381 to the CPU in this fashion.

BOARD DESIGN

The board is designed to plug into the existing NS32081's socket. All the NS32381's V_{CC} and GND connections, as well as all of the signals used in the 16-bit slave protocol are routed through the socket. No additional jumper wires are needed.

The socket interconnections for existing NS32032/016/008 systems are shown in *Figure 1*. The socket interconnections for existing NS32332/NS32CG16 systems are shown in *Figure 2*. The only difference between the two interconnection schemes is a 1 kΩ resistor used to pull up the NS32381's NOE pin when it is installed in an existing NS32332/NS32CG16 system.

The NS32381's seven V_{CC} and eight GND pins should be connected together by power and ground planes on the daughter board. A 0.01 μF decoupling capacitor should be installed on the daughter board.

HARDWARE CONSIDERATIONS

When the NS32381 FPU is installed in an NS32032/016/008 or NS32CG16 system, the FPU and CPU communicate in the NS32081 compatible 16-bit slave protocol. Since all of the signal lines used in the 16-bit slave protocol are routed through the existing socket, the use of the daughter board has no impact on the slave protocol used.

On the other hand, the NS32332 CPU and NS32381 FPU would normally communicate using the higher performance 32-bit slave protocol. Since the upper 16 bits of the data bus and the NS32381's $\overline{SDN332}$ signal cannot be routed through the existing socket, the 16-bit slave protocol must still be used when using the daughter board.

SOFTWARE CONSIDERATIONS

The NS32381 is fully software compatible with the NS32081. Code written for the NS32081 will run without any alterations on the NS32381. However, four new floating point instructions have been added to the NS32381's instruction set. These instructions may be used when the NS32381 is coupled with the NS32332 or NS32CG16 CPUs. Recognition of the new instructions is enabled by pulling the FPU's NOE pin high. Refer to the NS32381's data sheet for details on the new instructions.

PERFORMANCE GAINS

Simply by upgrading to the NS32381, floating point throughput will increase by up to 50% in a 10 MHz system. If the CPU is upgraded to a 15 MHz version at the same time, floating point throughput will increase by up to 100%. These gains are realized without any code changes. Further performance gains can be realized by taking advantage of the new NS32381 floating point instructions and expanded register set.
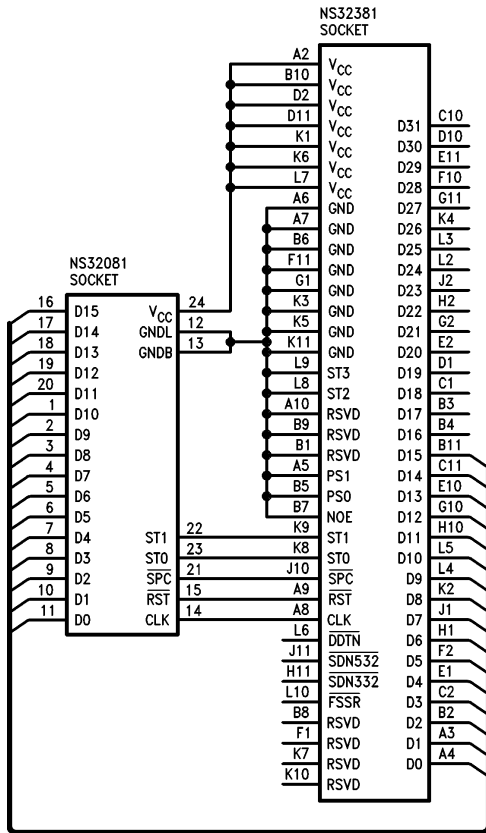
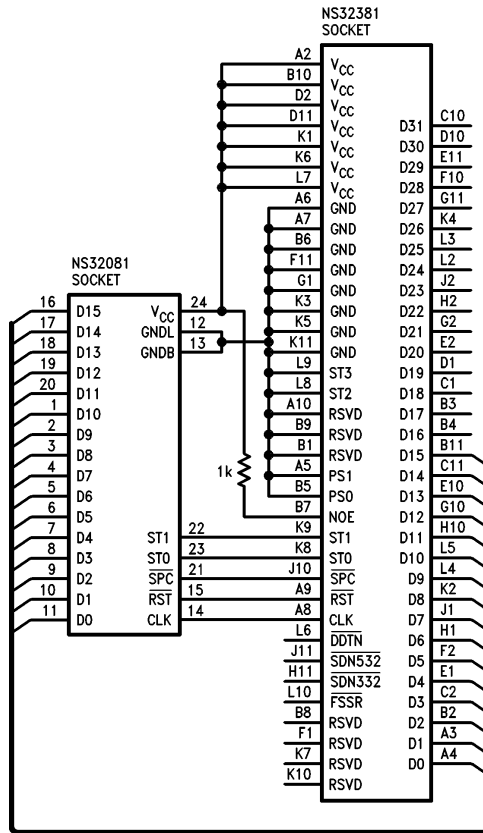FIGURE 1. Connections for NS32032/016/008 Systems

TL/EE/10459–1

FIGURE 2. Connections for NS32332/NS32CG16 Systems

TL/EE/10459–2

LIFE SUPPORT POLICY