TMS320 DSP
Number 46
DESIGNER'S NOTEBOOK
TEXAS INSTRUMENTS

TMS320C5x Memory Paging (Expanding its Address Reach)

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Design Problem How can I extend the address space of a 'C5x device?

Solution Since a 'C5x is a 16-bit machine with a 16-bit address, memory paging is needed if more than 64K of memory is to be addressed in a particular space. An external device needs to supply the upper addresses beyond the 16-bit memory range. This is done by having the DSP write a value to a register located in its I/O space whose data lines are the higher address bits. An example is shown below in Figure 1.

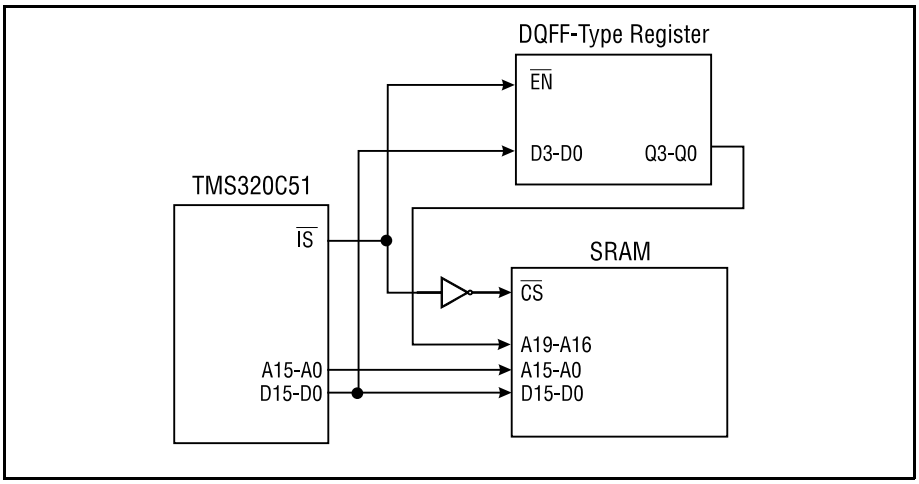

Figure 1. 'C5x paging hardware

Since the bank switch requires some action from the DSP, frequent switching between banks is not very efficient. It would be best to partition tasks within a bank and switch banks when starting new tasks. It may even be desirable to fix a certain part of the memory as non-pageable where the task manager would run (or use internal memory). This task manager kernal could determine on which page a called function resides and swap banks accordingly.

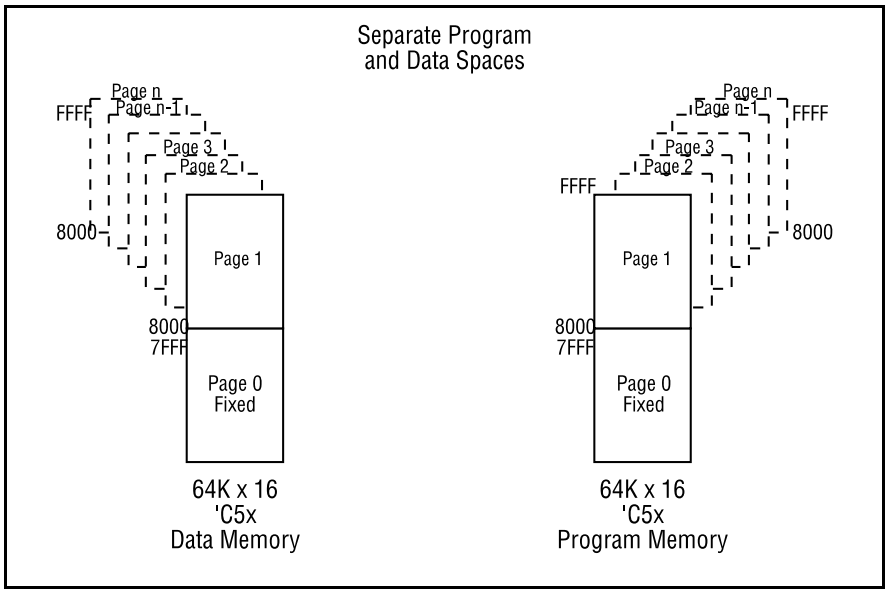

Figure 2. General DSP memory map (separate program and data)

An example of a separate program and data scheme is shown above in Figure 2 with a fixed 32K page 0 in the lower half of memory and pageable 32K blocks in upper memory.

Thus in software, any task function would be called through the task manager from the main code. For example:

```
main()
{
     taskman(task1, parms...);

}
void taskman(task, parms...)
{
     case task{

          task1:
               asm (OUT pa0, BANK1)
               task1(parms...);

          task2: asm (OUT pa0, BANK2)
     return(1)
}
task1 (parms. . . )
{

     return(1)
}
```

At present, the TMS320 debuggers do not understand paged code for various spaces. They only understand page 0 for program, page 1 for data, and page 2 for I/O (1994 'C5x Debugger Users Guide pages 13-32 and 13-33). Any of these spaces may be paged by the user. The debugger, which is unaware of paging, will display the data values after the user reads the space. Also, if the symbol information for a new page is desired, then doing an "sload" of the particular file containing a maximum of 64K (per page) must be done. The linker, on the other hand, understands up to 256 multiple pages (page 8-21 of Fixed-Point Assembly Tools). Thus one may combine the object files of each page into a single `.out` file using the linker. A smart loader can be written by the user to load the entire program and data into the specific system. The user must remember that the linker numbers its pages from 0 to 255 and therefore must be verified with the DSP memory map. For example data memory page 7 may actually arbitrarily correspond to linker page 12.

With these techniques, a user may extend the address reach of a 'C5x far above the 64K per memory space limited by the 16 address bits, allowing the use of more verbose code on a cheaper fixed-point platform. TI is presently in the process of studying the alternatives for cohesive expanded address reach support for all its tools.