EE461 Microprocessor-based Digital Design

Memory Systems

Solutions

1. The PIC16F874 does not export its address bus to the outside world. How, then, could devices that require addresses—such as memory devices, for instance—be connected to a PIC16F874? Outline a design and provide a rough schematic diagram for a system that would permit a PIC16F874 driven by a 4 MHz clock to operate two memory devices with the following characteristics:

   - 10-bit data in each addressable location
   - 16-bit address
   - a R/W control line
   - a CS chip-select control line
   - a 200 ns access time (this is the time it takes for the memory to retrieve data in the case of a read or store data in the case of a write.)

   Your solution needs to explain how a memory read would work, how a memory write would work, and the timing associated with both of these operations.

SOLUTION

One scheme that would work would be to use

- Port A, Bit 0 for the CS_0 chip-select control line of device 0;
- Port A, Bit 1 for the CS_1 chip-select control line of device 1;
- Port A, Bit 2 for the R/W control line;
- Port B for memory address bits A15 through A8;
- Port C for memory address bits A7 through A0;
- Port A, bits 4 and 3 for memory data bits D9 and D8 respectively, and
- Port D for memory data bits D7 through D0.

With a 4 MHz clock the PIC16F874 has a 1 µs instruction cycle. This makes the timing of the memory devices easy to deal with: the memory will respond in much less time than it takes to execute even a single PIC16F874 instruction.

To perform either a read or a write operation, the PIC would have to

- output both halves of a 16-bit address on Ports B and C,
- either place a 1 or a 0 on the R/W control line, depending on whether a read or a write was desired,
- place 10 bits of data on Port A, bits 4 and 3 and Port D (in the case of a write)
- lower either the CS_0 or the CS_1 control line (but not both) to select one of the two memory devices, and
- read 10 bits of data on Port A, bits 4 and 3 and Port D (in the case of a read).