FIFO Architecture, Functions, and Applications

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Abstract

First-in first-out memories (FIFOs) have progressed from fairly simple logic functions to high-speed buffers incorporating large blocks of SRAM. This application report takes a detailed look at the evolution of FIFO device functionality and at the architecture and applications of FIFO devices from Texas Instruments (TI™). The first part presents the different functions of FIFOs and the resulting types that are found. The second part deals with current FIFO architectures and the different ways in which they work. Finally, some application examples are given to illustrate the use of FIFOs from the TI product spectrum.

Introduction

In every item of digital equipment there is exchange of data between printed circuit boards (PCBs). Intermediate storage or buffering always is necessary when data arrive at the receiving PCB at a high rate or in batches, but are processed slowly or irregularly.

Buffers of this kind also can be observed in everyday life (for example, a queue of customers at the checkout point in a supermarket or cars backed up at traffic lights). The checkout point in a supermarket works slowly and constantly, while the number of customers coming to it is very irregular. If many customers want to pay at the same time, a queue forms, which works by the principle of first come, first served. The backup at traffic lights is caused by the sporadic arrival of the cars, the traffic lights allowing them to pass through only in batches.

In electronic systems, buffers of this kind also are advisable for interfaces between components that work at different speeds or irregularly. Otherwise, the slowest component determines the operating speed of all other components involved in data transfer.

In a compact-disk player, for instance, the speed of rotation of the disk determines the data rate. To make the reproduced sound fluctuations independent of the speed, the data rate of the A/D converter is controlled by a quartz crystal. The different data rates are compensated by buffering. In this way, the sound fluctuations are largely independent of the speed at which disks rotate.

A FIFO is a special type of buffer. The name FIFO stands for first in first out and means that the data written into the buffer first comes out of it first. There are other kinds of buffers like the LIFO (last in first out), often called a stack memory, and the shared memory. The choice of a buffer architecture depends on the application to be solved.

FIFOs can be implemented with software or hardware. The choice between a software and a hardware solution depends on the application and the features desired. When requirements change, a software FIFO easily can be adapted to them by modifying its program, while a hardware FIFO may demand a new board layout. Software is more flexible than hardware. The advantage of the hardware FIFOs shows in their speed. A data rate of 3.6 gigabits per second is specified for a Texas Instruments (TI™) SN74ABT7819 FIFO.

This application report takes a detailed look at TI FIFO devices. The first part presents the different functions of FIFOs and the resulting types that are found. The second part deals with current FIFO architectures and the different ways in which they work. Finally, some application examples are given to illustrate the use of FIFOs available from TI.

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