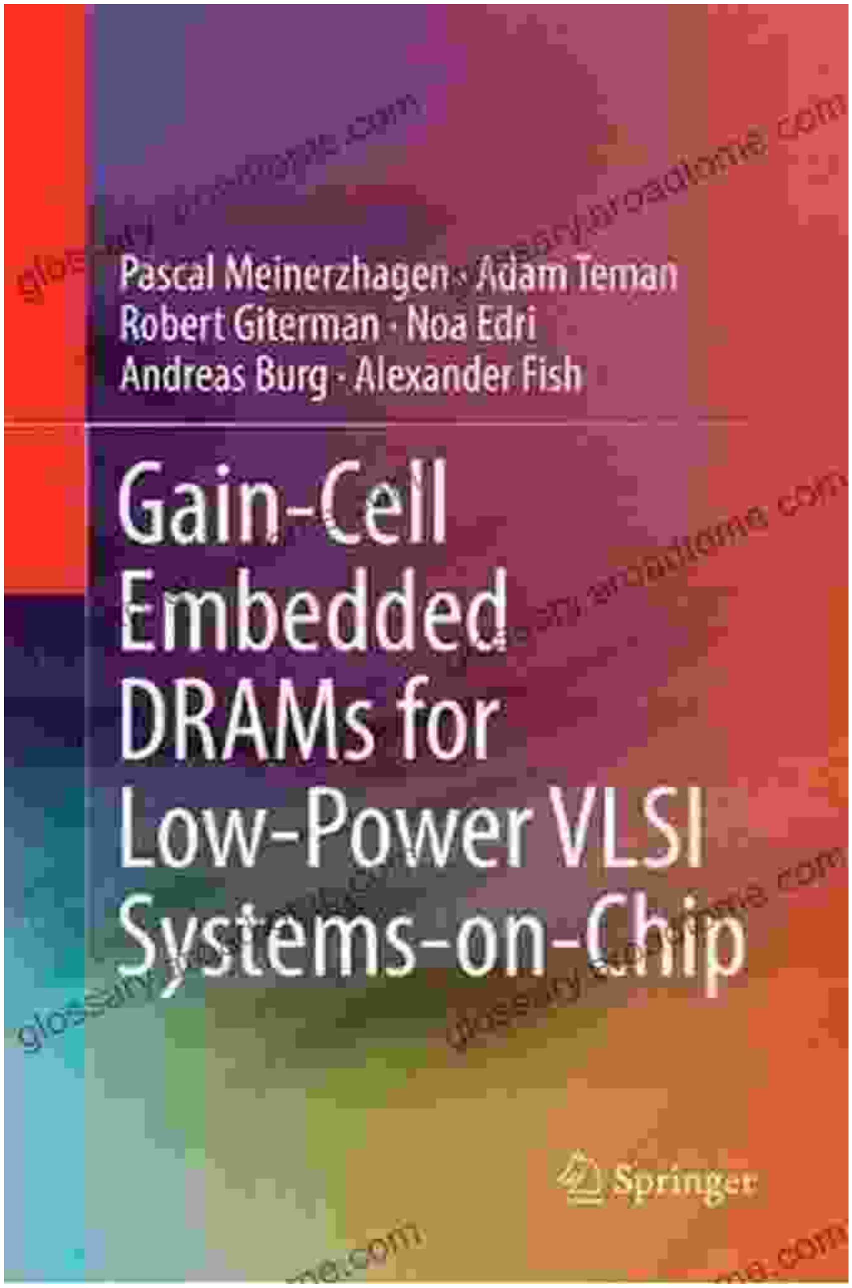
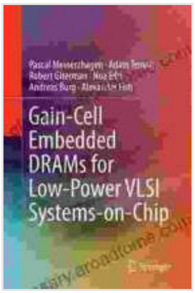
Gain Cell Embedded DRAMs for Low Power VLSI Systems on Chip



Embedded DRAMs (eDRAMs) are a type of memory that is integrated into a VLSI chip. They offer a number of advantages over traditional DRAMs, including lower power consumption, higher speed, and smaller size. As a result, eDRAMs are increasingly being used in low-power VLSI systems on chip (SoCs).



Gain-Cell Embedded DRAMs for Low-Power VLSI Systems-on-Chip by Gary B. Shelly

★★★★★ 5 out of 5

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One of the most important aspects of eDRAM design is the gain cell. The gain cell is responsible for amplifying the small signal from the memory cell to a level that can be read by the sense amplifier. The design of the gain cell has a significant impact on the power consumption, speed, and reliability of the eDRAM.

In this article, we will discuss the different types of gain cells that are used in eDRAMs. We will also compare the performance of these gain cells in terms of power consumption, speed, and reliability.

Types of Gain Cells

There are two main types of gain cells that are used in eDRAMs: folded cascode gain cells and sense amplifier gain cells.

Folded Cascode Gain Cells

Folded cascode gain cells are the most common type of gain cell used in eDRAMs. They offer a good trade-off between power consumption, speed, and reliability.

Folded cascode gain cells are made up of two transistors, a PMOS and an NMOS. The PMOS is connected to the memory cell, and the NMOS is connected to the sense amplifier. When the memory cell is read, the PMOS turns on and the NMOS turns off. This causes the voltage at the output of the gain cell to rise. The sense amplifier then detects the voltage rise and amplifies it to a level that can be read by the CPU.

Folded cascode gain cells are relatively power efficient because they only use two transistors. They are also relatively fast because they have a short signal path between the memory cell and the sense amplifier. However, folded cascode gain cells are not very reliable because they are susceptible to noise and process variations.

Sense Amplifier Gain Cells

Sense amplifier gain cells are more complex than folded cascode gain cells, but they offer better performance in terms of power consumption, speed, and reliability.

Sense amplifier gain cells are made up of four transistors, two PMOS and two NMOS. The PMOS transistors are connected to the memory cell, and the NMOS transistors are connected to the sense amplifier. When the memory cell is read, the PMOS transistors turn on and the NMOS transistors turn off. This causes the voltage at the output of the gain cell to rise. The sense amplifier then detects the voltage rise and amplifies it to a level that can be read by the CPU.

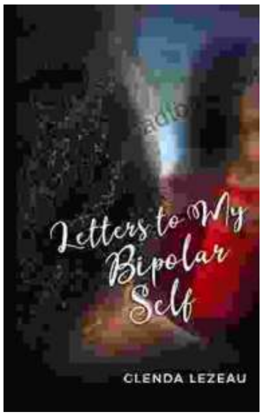
Sense amplifier gain cells are more power efficient than folded cascode gain cells because they use fewer transistors. They are also faster because they have a shorter signal path between the memory cell and the sense amplifier. However, sense amplifier gain cells are not as reliable as folded cascode gain cells because they are more susceptible to noise and process variations.

Comparison of Gain Cells

The following table compares the performance of folded cascode gain cells and sense amplifier gain cells in terms of power consumption, speed, and reliability.

| Gain Cell Type | Power Consumption | Speed | Reliability | |---|---|---|---| | Folded Cascode | Low | Medium | Low | | Sense Amplifier | High | High | Medium |

The choice of gain cell type depends on the specific requirements of the eDRAM. If low power consumption is the most important factor, then a folded cascode gain cell is the best choice. If speed is the most important factor, then a sense amplifier gain cell is the best choice. If reliability is the most important factor, then a folded cascode gain cell with a sense amplifier is the best choice.



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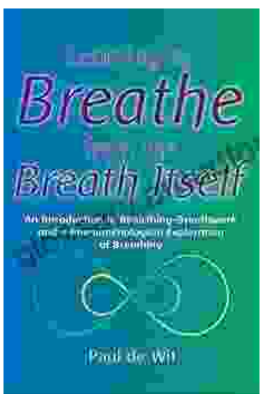

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