A 476-gate-count Dynamic Optically Reconfigurable Gate Array in a standard 0.35um CMOS Technology

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Background and Overview

Background

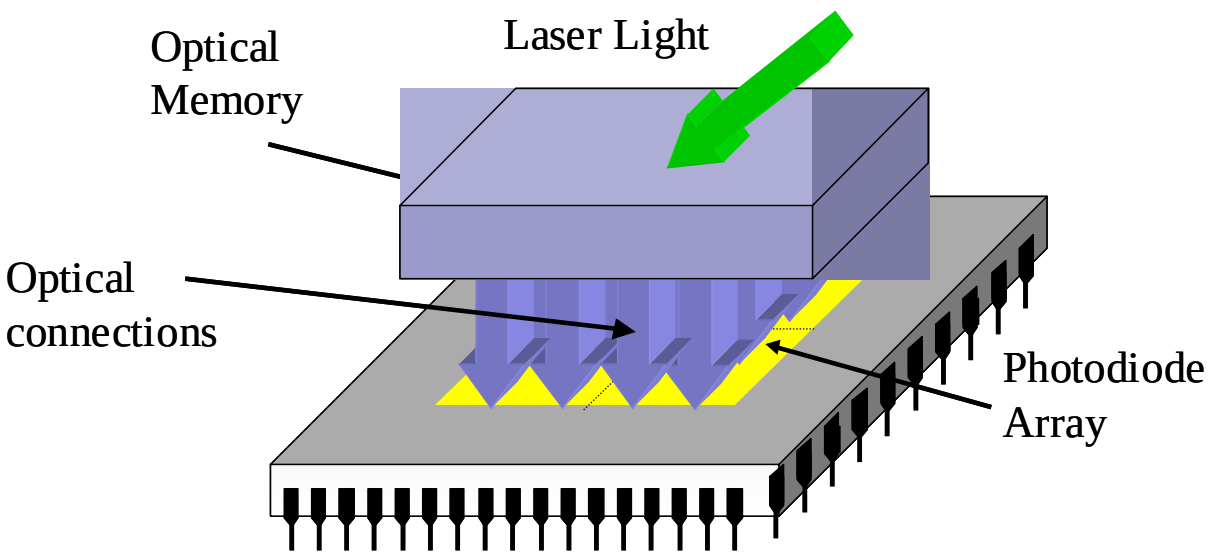
- Recently, VLSI technology progress is slow down.
- Semiconductors are near the limits of miniaturization.

■ORGAs can exceed the gate count of conventional VLSI.

Overview

- ORGA consists of holographic memory, laser array, gate array VLSI.

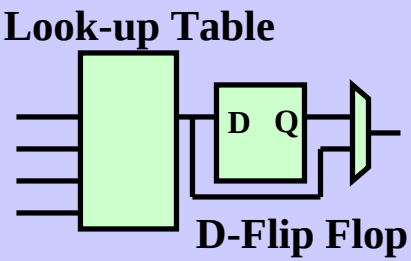
- Advantages
  1) Large virtual gate count
  2) Fast Reconfiguration



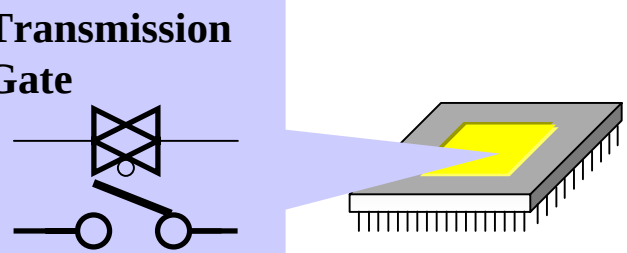
Dynamic Reconfiguration Advantage

Drawback of Conventional Programmable Devices

LUT structure

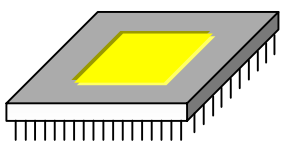


SM structure



Drawback is based on LUT and transmission gate structure

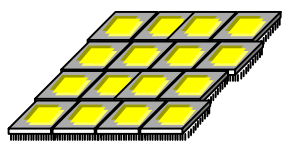
Conventional Implementation



Multi-Functions Unit
or General purpose Unit

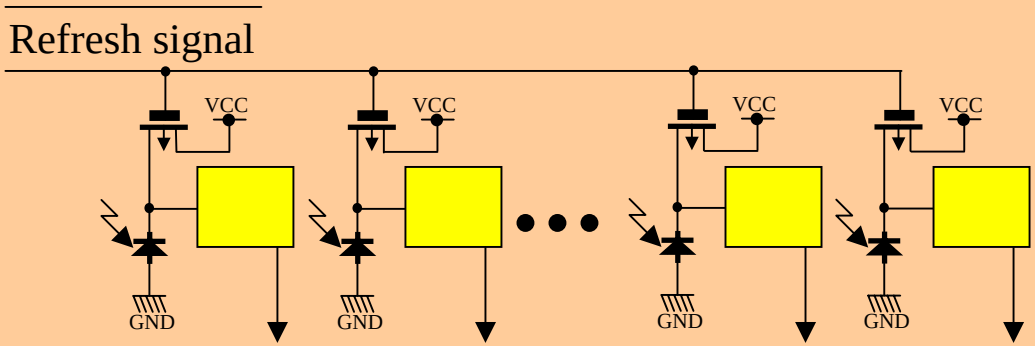
Dynamic reconfiguration Implementation

Single Function Unit



Parallel computation

Dynamic optical reconfiguration circuit



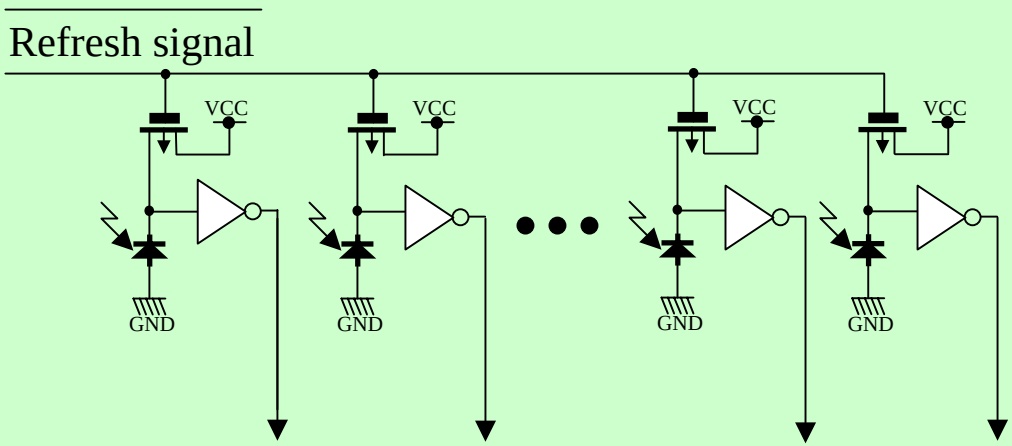
Configuration signals for Gate Array

Latch, Flip-Flop, or Memory

1bit-Reconfiguration Circuit with a static memory function

297 $[\mu m^2]$

Dynamic optical reconfiguration circuit

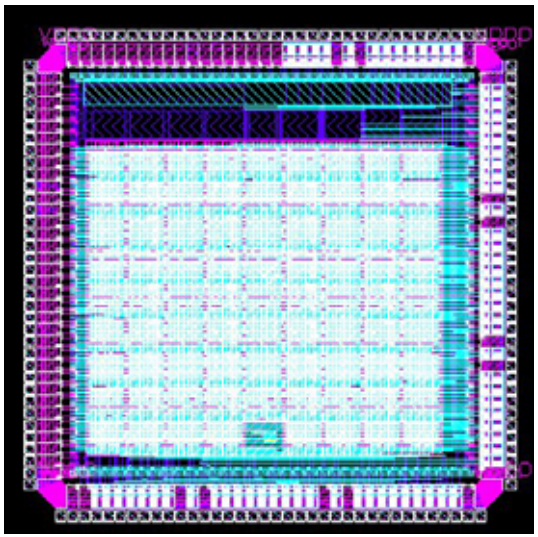


Configuration signals for Gate Array

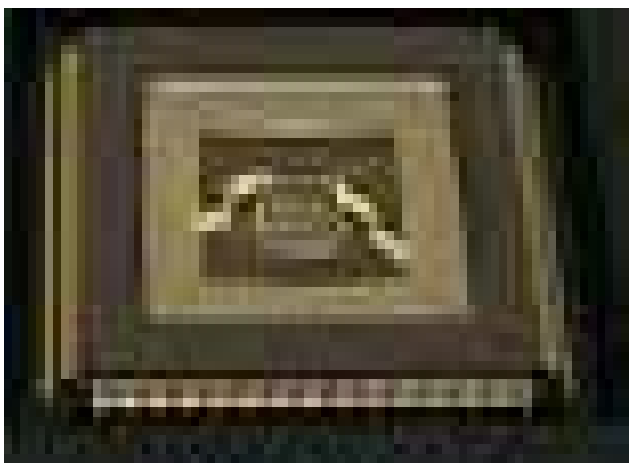
1bit-Dynamic Type Reconfiguration Circuit

36 $[\mu m^2]$

Design of a high density DORGA



CAD Layout



Chip Photograph

Specification of a high density DORGA

Technology	0.35 μm double-poly triple-metal CMOS process
Chip size	4.9 $\times$ 4.9 [mm]
Supply Voltage	Core 3.3V, I/O 3.3V
Photodiode size	9.1 $\times$ 8.8 [μm]
Distance between Photodiodes	h.=42, v.= 33 [μm]
Number of Photodiodes	3,696
Av. Aperture Ratio	3.1%
Number of Logic Blocks	28
Number of Switching Matrices	36
Number of Wires in a Routing Channel	8
Number of I/O bits	64
Gate Count	476