Faster, Cooler, Simpler Design Solutions for Energy-Efficient SOC Systems

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FD-SOI

STI life.augmented
Moore’s law challenge

- Transistor downscaling
  - Better performance
  - Better power
  - Better cost

- Leverage previous node infrastructure
- Ecosystem
- Design legacy
- Manufacturing
- Market adoption
- Yield
- Continue Moore’s law

20nm Bulk
- Double patterning cost
- Traditional transistor limits

FinFET

FD-SEI

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Bulk Transistor Reaching Limits at 20nm

Transistor reaches limit in performance, power and scaling due to:
- leakage
- High variability
- Poor electrostatic control

FD-SOI = 2D

FinFET = 3D
FD-SOI: addressing Power sensitive Markets

FinFet

High end servers

Laptops & tablet-PC

Networking Infrastructure

Smartphone

Consumer Multimedia

Internet of Things, wearables

Automotive

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FD-SOI: unique value proposition

**Processors and digital logic**
- 30% better than bulk
- Unique body bias booster
- Unique at low voltage

**Embedded Memories**
- Unique SRAM / TCAM
- Unmatched power/performance

**Analog & High-speed**
- Better performance & variability
- Open access to «digital RF»

**POWER EFFICIENCY & PERFORMANCE**

**DESIGN & PRODUCTION**

**Simplicity & cost**
- Design
- Manufacturing
- Yield

**Safety critical design & reliability**
- Unique reliability enabling breakthrough in safety critical design (no redundancy)

**Ultra low energy design**
- Ultra low voltage enabling breakthrough for low energy devices
Extending the 28nm lifetime

28nm will be the longest process generation with the highest volume manufacturing.

FD-SOI extends the lifetime of 28nm by offering improved power and performance rivaling those from existing 20nm technologies (which come with much higher costs).

FD-SOI is very well suited for cost-sensitive markets requiring power efficiency and performance.

Networking infrastructure  Consumer multimedia  IoT  Automotive  Smartphone

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FD-SOI Roadmap

28nm FD-SOI
RF, Mixed signal
14nm FD-SOI
Ultra Low voltage
Derivatives
Body Bias, cost, simplicity, reliability
Derivatives
Additional 28nm FDSOI options
Enabling new markets

Additional features:
+35% speed
-50% power
Perf & power path

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Faster, Cooler, Simpler technology

- FD-SOI transistors up to 30% faster than bulk
- Outstanding power efficiency at every level
- Extensive use of existing fab infrastructure

Enhanced design options

- Back-biasing as a flexible and powerful optimization
- Very large operating range for the same design
- Ultra-wide range DVFS

Mature process & ecosystem

- Ecosystem ready at all stages: wafer supply, design and manufacturing
- Extended IP offer
- PDK is available now
- Strategic collaboration between Samsung and ST

FD-SOI gives your SOC competitive advantages
Best in class efficiency

Faster, Cooler, Simpler

FBB dynamic modulation to get the best total power

Best dynamic power /leakage tradeoff

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Memories

- Similar performance with huge ~5X less leakage in 28 FD-SOI vs. Bulk
- Very low neutron-SER SRAM, 100× better than bulk
- Alpha quasi-immunity → cost savings for packaging

Analog & High-speed

- FD-SOI analog performance far exceeds Bulk
- New design opportunity by controlling analog device characteristics through body biasing techniques
Forward Body Biasing: An extremely powerful and flexible concept in FD-SOI

- Performance boost
- Reduce power consumption at a given performance requirement
- Process compensation reducing the margins to be taken at design
- Seamless inclusion in the EDA flow

Comparatively easy to implement
If you’ve ever done DVFS you’ll have no difficulty with Body Biasing

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FD-SOI significantly reduces the process complexity

28nm FD-SOI uses less masks than other technologies

<table>
<thead>
<tr>
<th>Interconnect Process</th>
<th>Process complexity</th>
<th>CAPEX</th>
<th>Lead time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same</td>
<td>15% fewer steps in FD-SOI</td>
<td>Same equipment as bulk</td>
<td>10% Better</td>
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</table>

Device Process: 80% common, 20% specific

Process development: Only 20% Front-End steps to develop

Scalability: Down to 10nm

Up to -15% vs. 28nm Bulk LP (HKMG)
Up to -30% vs. 28nm Bulk G mobile
Application example: wearable SoC

SoC Architecture

- RF
- Logic processing
- CPU & Memories
- Power Management

SoC Power Consumption

- Power Supply Loss
- RF
- Logic processing
- SPU & Memories
- Other

34mw*

<10mw*

<5mw**

X3 to X6 Power Consumption Improvement with FD-SOI

* Measured on Silicon / Product Simulation
** Projection

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Example: Power efficiency in Mobile Infrastructure

Wide DVFS combined with Body Bias Voltage Scaling make the difference.

FD-SOI: up to 70% better energy consumption vs HPC

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Ecosystem available in the whole chain

**FD-SOI**
- Wafer suppliers
  - Several SOI wafers suppliers

**FD-SOI**
- Design solutions
  - EDA Suppliers
  - Design flow
  - Libraries
  - IP porting

**FD-SOI**
- Silicon manufacturing
  - Volume production at ST facility today
  - Early 2015 at Samsung facility

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### Standard cells
- 8T / 12T
- RVT / LVT
- Poly bias: 0.4, 10, 16nm
- Low power: Isolation, Level shifters

### Memories
- Low voltage
- Single port / Dual port
- ROM
- Ultra-high speed SRAM

### Specific
- Process monitoring

### Analog IPs
- Antifuse memories
- IOs
- PLLs, V/T sensors, eSwitch

### Advanced IPs
- Voltage regulators
- Vbias generators
- ADC // DAC
- Frequency synthesizer
- Oscillators
- Memory interfaces
- (DDR3/4, LPDDR, ...)
- Sensors
- (process, thermal, voltage)
- Very-High speed links
- (PCIex3, SATA3, UDB3)

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Samsung is licensing the 28nm FD-SOI design platform.

Samsung and ST will support common FD-SOI library & IP.

The PDK is available now so customers can design immediately.
• An extended strategic collaboration between Samsung and STMicroelectronics

• Samsung is licensing 28nm FD-SOI
  • Available to Samsung foundry customers
  • Extends ST manufacturing capacity

• Strengthen FD-SOI ecosystem and confirms momentum
  • Offers customers choice and security of supply
  • Full design compatibility Samsung – ST. Same design can be manufactured in both Fabs
  • Accelerates adoption in the targeted market
  • IP availability through 3rd parties enablement
FD-SOI is easy to use, with simple, cost-effective process.

FD-SOI offers enhanced options bringing high flexibility to the design.

FD-SOI extends the 28nm lifetime, offering outstanding efficiency at all levels.

FD-SOI is available today for production, with an established ecosystem.

FD-SOI scalable technology: 14nm ongoing / cost & capex optimized.