FDSOI: FROM SUCCESSFUL COLLABORATIVE R&D TO SUCCESSFUL SILICON RESULTS

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Agenda

• FDSOI Technology and advantages

• UTBB FDSOI: A Collaborative Success

• 28nm FDSOI : 1st Product Silicon results

• Conclusions
Planar Fully Depleted Technologies: FD-SOI Advantages
Bulk Transistor is reaching its limits

Limited body bias capability

Complex channel architecture

Heavily Doped Wells

Fully Depleted devices are mandatory to continue the technology roadmap

FD-SOI = 2D

FinFET = 3D
Introducing UTBB Planar FD-SOI

Current planar bulk Transistor limits

FinFET = 3D

FD-SOI = 2D

FD-SOI Advantages

- **Fully Depleted Channel**
  - **Ultra-thin Body (FASTER, COOLER)**
    - Excellent short-channel immunity
  - No channel doping, no pocket implant
  - Improved VT variation, matching
  - Improved Low-Voltage operation
  - Improved SRAM Variability, VDDMIN
- **Ultra-thin BOX (FASTER, COOLER)**
  - Enables Back-bias control of Vt
  - Unique to FD-SOI

**Planar Technology (SIMPLER)**
- Reuse Bulk Process & Design
Planar UTBB FD-SOI: Analog Technology

**Body Bias**: 85mV/V VTh adjust in FD-SOI

**No channel doping**: better matching for short channel devices
- Eg Diff Pairs => More gain, Less Power
- Application: High Speed ADC

**No pocket implant**: better gain compared to bulk

**New Analog Techniques**:
- Dyn Trimming in Diff Pairs
- Built-in gain controlled amplifier (GCA)
- Switch : 10x Ron/Roff ratio vs Bulk or Fin

**Analog Gain** = \( \frac{Gm}{Gd} \)
Best in class energy efficiency
FD-SOI is Scalable

• ST and its R&D Partners have enabled an FD-SOI 3-node roadmap:

• 28nm, 14nm and 10nm
UTBB FDSOI: A Collaborative Success Story
UTBB FD-SOI, A Long R&D Success Story

1997, CNET
Silicon On Nothing
Fabrication of thin BOX on ordinary Bulk wafers within the CMOS process

1999
ST & LETI
Fabrication of SON silicon

2000
Prized with the Rappaport Award for the best IEEE EDS paper of year 2000

Dec 2010:
28nm FDSOI Enablement Start:
“DECADE” ST-Mentor

2009
FD-SOI on Thin BOX
Thin box wafers developed by Soitec

2012
28nm FD-SOI Available for production

2010:
FD-SOI on Thin BOX
Thin box wafers developed by Soitec
UTBB FD-SOI Symbiosis

A WORLDWIDE DEVELOPMENT ECOSYSTEM

CMOS Technology Alliances
ISDA: 32/28/20 Bulk LP
Pre-T0: 14nm & FDSOI

ST experience enabling the ENERGY EFFICIENCY RACE
28nm FD-SOI, An industrial reality at ST
Planar UTBB FD-SOI: Some Facts!

FEOL & BEOL construction

Interconnection cross-section

FD-SOI Transistor cross-section
Planar UTBB FD-SOI: Some Silicon Facts!
Dynamic & Static Performances

AC Performance on inverter RO

DC Transistor Output Characteristic
Reduced Inter-Cell Dispersion

Planar UTBB FD-SOI Technology is Simpler than BULK

1) Tighter simulation corners for design
2) Increased predictability of simulation solution
3) At chip level, reduced circuit performance variability even at early process development
Improved Memory Minimum Voltage

Single-Port High Density Cell [0.120um² ; 4Mb]

-100mV

Vmin (V)

Cumul %

Vnom

Vmin 28FD

Vmin 28LP

28FD

28LP
Body Bias: Speed/Leakage Benefits
Dynamic Process Scaling

Forward Body Bias effectiveness across Vdd

Reverse Body Bias effectiveness

Planar FD-SOI Technology at 28nm and below for extremely power-efficient SoCs  
February 2013
2013-CES January/ Barcelona February: 28nm FDSOI

- ARM Cortex Dual-A9 @3 GHz
  - Twice as fast as best A9-Quad @ 1.4 GHz
- ARM Cortex Dual A9 @ 1 Ghz at 0.63V
UTBB FDSOI: Conclusions

- Available for Design: Now!
- Enable 28nm Products PPA Improvements
- 1st Product Silicon: Dec ‘12

- Available for Design H1 2013
- Enable New High Performance Products

FD-SOI Provides Unique Value

Faster.

- Transistors run up to 30% faster than bulk CMOS

Cooler.

- More power efficient than bulk CMOS devices
- End user devices run cooler and last longer

Simpler.

- The manufacturing process for FD-SOI is much simpler
  - and makes extensive use of existing fab infrastructure
- Design porting from bulk is simple and fast
Conclusions

- WW UTBB FD-SOI R&D eco-system enabled ST to go from concept to first full product

- ST is committed to UTBB FD-SOI
  - 28nm node now open for risk production
  - ST next gen consumer products in FD-SOI
  - FDSOI is viable and competitive until 10nm

- 28nm FDSOI is a Breakthrough technology
  - offered to customers seeking a power/performance advantage
Thank You!

FD SOI:

FASTER, COOLER, SIMPLER

FD-SOI basics
http://www.youtube.com/watch?v=uvV7jcpQ7UY

1GHz CA9 @ 0.6V demo at CES.
http://youtu.be/9FKxUGRm9LQ