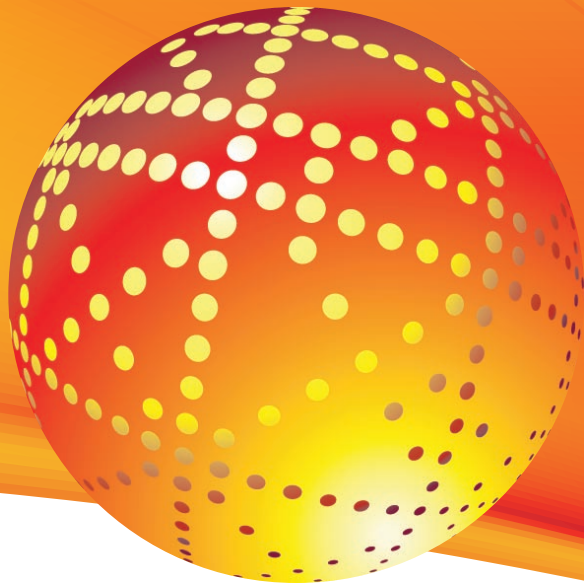


## The Foundry Guide to Success with High K Metal Gate (HKMG)



## FOUNDRY HAS A NEW TECHNOLOGY LEADER

### The Foundry Guide to Success with High K Metal Gate (HKMG)

HKMG is one of the most significant innovations in CMOS fabrication since the inception of silicon VLSI. HKMG enables a revival in transistor scaling that had stalled with poly SiON gate technology. GLOBALFOUNDRIES is driving the global standard for High K Metal Gate (HKMG) with seven world-leading semiconductor product companies including Freescale, IBM, Infineon, NEC, ST, Samsung, and Toshiba. This HKMG solution is far superior to that currently pursued by the other leading foundries, in both scalability (die size, design compatibility, performance) and manufacturability. This solution is a "Gate-First" approach that shares the process flow, design flexibility, design elements and benefits of all previous nodes based upon poly SiON gates.

**Fact 1:** There are many methods to implement HKMG; it is an oversimplification to say there are only two, namely, 'Gate First' and 'Gate Last'. Notably, there is wide variability in the 'Gate Last' approaches.

**Fact 2:** The two major pure play foundries are planning risk production for HKMG in 2010; their stated implementations differ widely from each other, in both approach and benefits.

**Fact 3:** GLOBALFOUNDRIES offers the superior HKMG solution, across all desirable categories. Six proofs of this fact follow inside.

**"If you can't explain it simply, you don't understand it well enough."**

**- Albert Einstein**



GLOBALFOUNDRIES

### Proof #1

#### Gate Density, Die Size, Bit Cells:

The approach of GLOBALFOUNDRIES enables full scaling from 40nm to 28nm, where the approach of the other leading foundry suffers a 10% or much greater hit in die size, depending on the user's standard cell library. Figure 1 shows the cell layout and routing advantages of GLOBALFOUNDRIES' design rules that allow tighter pitch, dual orientation poly gates and flexible poly interconnect, in contrast to the single orientation poly restrictions by the other leading foundry. In order to mitigate the penalties imposed by these poly restrictions, an additional metal layer must be utilized to prevent the cell from blowing up 10-20% or more.

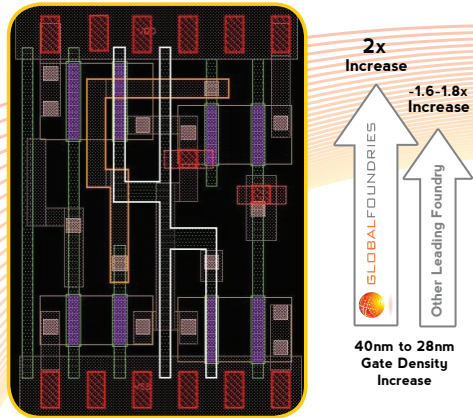
GLOBALFOUNDRIES also enables >50% SRAM area scaling – featuring a 0.120um<sup>2</sup> high density bit cell. This is the smallest foundry bit cell offered for the 28nm node.

### Proof #2

**Design Compatibility:** Due to compatibility with the conventional poly gate processing flow, GLOBALFOUNDRIES enables a reduction in design complexity by allowing preservation of design architecture and layout style, thereby leveraging design investments with IP reuse.

This includes:

- Use of conventional poly resistors, poly eFuse (without added complexity/cost of additional mask layers)
- Simpler path for half node migration (optional cost down path from 32nm to 28nm)



**Figure 1.** Dense routing is enabled by GLOBALFOUNDRIES' HKMG. Layout schematic shows Metal 1 outlined in brown. Poly interconnect, outlined in white, enables flexible connection and substantially smaller die size of ~10-20% or more depending on user's standard cell library.

### Proof #3

**Performance:** GLOBALFOUNDRIES' HKMG enables full scaling from 40nm; i.e., 28nm transistors offer up to 40% higher performance than 40nm at comparable leakage with 50% lower energy per switch and 50% lower static power. As a leading manufacturer of x86 CPU's, GLOBALFOUNDRIES well understands the constraints and trade-offs of performance, power and area. The major competitor's offerings have limitations in the breadth of transistor and Vt offerings versus a wider variety from GLOBALFOUNDRIES as described below.

**Super High Performance (SHP):** This is the flagship technology of GLOBALFOUNDRIES, offering outstanding x86 CPU performance on an SOI substrate.

**High Performance (HP):** 28nm-HP is a high performance transistor delivered on a bulk silicon substrate. It targets high performance and general purpose applications such as graphics, game consoles, storage, consumer electronics, and wired networking. 28nm-HP supports low, standard, and high Vt options.

**Super Low Power (SLP):** The high performance offerings noted above are in addition to the super low power offering delivered on a bulk silicon substrate for mobile applications which has four Vt's (high, regular, low, and super low) for design flexibility and offers the ultimate in small die size and cost. SLP is a lower cost technology relative to HP, in terms of the performance elements utilized to boost carrier mobilities.

### Proof #4

**Ability to Ramp and Time-to-Volume:** Leakage emerged as a major yield limiter at the 45/40nm node, preventing other leading foundries from ramping production (See figure 2).

This painfully underscored the fact for foundry customers that a risk production date on a roadmap is one thing, ramping production is quite another. Risk production was offered by the other leading foundry in October 2007, yet two years later yields remain insufficient for what should be a mature technology. In contrast, GLOBALFOUNDRIES surpassed the 25K per quarter wafer shipment mark with high yielding devices in less than 3 quarters. GLOBALFOUNDRIES supports a leader in x86 CPU's that ramps large complex high performance die to drive low defect density with high manufacturability and yields. Initial 32nm CPU products will be sampling in 2010. The 32nm HKMG ramp will precede the 28nm HKMG ramp of other GLOBALFOUNDRIES customers by about one quarter. Thus, the CPU leader provides a unique

and ideal early adopter that drives manufacturability for the other customers of GLOBALFOUNDRIES.

### Proof #5

#### Customer Product Introductions in Q1 2010:

GLOBALFOUNDRIES' customers will begin to announce HKMG product results in early 2010 - not test chips, not 64M SRAMS, not IP shuttle results, but full products. As with the 45/40nm ramp, this will be far ahead of any other pure play foundry.

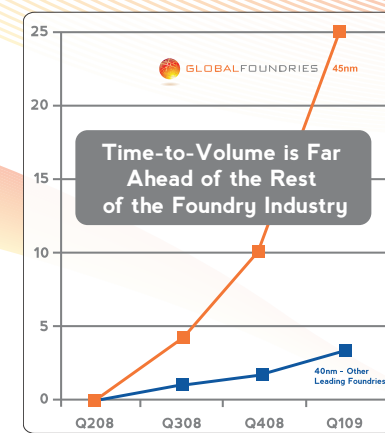
### Proof #6

#### Global Mindshare and Dedicated Capacity:

In addition to expressing a vision to become the world's first truly global foundry, GLOBALFOUNDRIES also seeks to harness the world's intellectual resources to deliver maximum value to customers and fully unlock their potential to innovate. In this vein, GLOBALFOUNDRIES is closely aligned in HKMG R&D and production with several other semiconductor manufacturing leaders including Freescale, IBM, Infineon, NEC, Samsung, ST, and Toshiba. This alignment is in the High K materials stack, the detailed process fabrication steps, the specific design rules, and the specific transistor models. GLOBALFOUNDRIES is driving the global standard for HKMG with these seven top tier product companies.

This alliance presents a global manufacturing capacity and design ecosystem for HKMG that is far greater than the other leading pure play foundry, which in fact will split 32/28nm development, capacity, and yield learning between poly SiON and HKMG.

### 45/40nm Production Ramp



\*Market data compiled by International Business Strategies

**Figure 2.** 45/40nm foundry production ramp. Similar leadership by GLOBALFOUNDRIES is anticipated for the 32/28nm foundry industry production ramp of HKMG-based technologies in 2010-2011.

In contrast to the unity of GLOBALFOUNDRIES and its partners, the so-called 'Gate Last' approaches are not unified. For example, a leading integrated device manufacturer of x86 CPU's has two widely different approaches at 45 and 32nm. At 45nm the High K dielectric and initial layer of gate metal are deposited BEFORE the dummy poly; this process is truly a hybrid of 'Gate First' and 'Gate Last'.

The number of companies and aggregated capacity aligned with GLOBALFOUNDRIES are anticipated to grow as the 32/28nm nodes mature and the technology is deployed beyond the current early adopters.

**Conclusion:** The table below summarizes the six proofs outlined above. Across all major categories, GLOBALFOUNDRIES is the best choice for HKMG production.

Summary of GLOBALFOUNDRIES Superiority in HKMG 32/28nm Solutions		
	GLOBALFOUNDRIES	Other Leading Foundry
Die Size	✓	
Design Compatibility	✓	
Performance	✓	
Ability to Ramp / Time to Volume	✓	
Product Proofs	✓	
Global Mindshare and Capacity	✓	

Poly SiON vs. HKMG? HKMG First vs. HKMG Last? The real questions are simply the following:

- (1) Which foundry offers the best solution for your 28nm product requirements?
- (2) Which foundry will be best prepared to ramp your products and support your business in time-to-market?

The first truly global foundry is ready to support your 28nm needs in technology and global capacity, with outstanding customer service. Please contact GLOBALFOUNDRIES for further information and facts on HKMG, or to schedule a seat on a 28nm HP or SLP shuttle.

