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### **High-voltage hype charges up foundries**

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Industry pundits proclaimed 2008 the year of analog. With the growth of the analog chip market far outpacing that of digital, a slew of foundry vendors jumped into the arena.

Still, the odds for analog foundries' survival aren't looking good, especially at a time when the analog foundry vendors face an IC market downturn, the breakout of a price war and mounting fears about intellectual property theft in China.

Most troubling of all is that--all of a sudden--there are just too many analog foundries.

## Top foundries in 2007

Analog providers are moving up the ranks

2007	Company	Foundry type	Location	2007 sales \$M	07/06 Sales %
1	TSMC	Pure-Play	Taiwan	9,813	1%
2	UMC	Pure-Play	Taiwan	3,755	2%
3	SMIC	Pure-Play	China	1,550	6%
4	Chartered	Pure-Play	Singapore	1,458	-5%
5	TI	IDM	U.S.	610	4%
6	IBM	IDM	U.S.	570	-5%
7	Dongbu	Pure-Play	South Korea	510	12%
8	Vanguard	Pure-Play	Taiwan	486	22%
9	X-Fab	Pure-Play	Europe	410	41%
10	Samsung	IDM	South Korea	385	413%
11	SSMC	Pure-Play	Singapore	350	8%
12	HHNEC	Pure-Play	China	335	6%
13	He Jian	Pure-Play	China	330	14%

Note: Tower Semiconductor bought Jazz Technologies in May, 2008.  
The combined company had sales of \$440 million in 2007.

SOURCES: IC Insights, company reports

That means too many vendors are chasing limited analog business, according to Gartner analyst Stephen Ohr. "There will be a shakeout," he predicted.

Many entered the analog foundry market via acquisition. Traditional digital IC foundry vendors have also begun offering analog and mixed-signal services.

Among the newcomers to the analog foundry business are: China's CSMC and Semiconductor Manufacturing International Corp. (SMIC), Germany's LFoundry and U.S.-based ON Semiconductor. ASMC, Austriamicrosystems, BCD, Dongbu HiTek, IBM, MagnaChip Semiconductor, NEC, Tower/Jazz, TSMC, Vanguard, X-Fab Silicon Foundries and others are also expanding their analog services.

As the digital foundry business matures, analog has emerged as a new battleground for many foundry vendors. Among analog chips, those in the high-voltage segment in particular are registering the fastest growth.

High-voltage processes are enabling the next wave of LEDs and power-management devices. Despite the market downturn, there is still a big spending cycle for LEDs in cars, lighting systems, PCs and other equipment. The total LED market is projected to jump from \$3.6 billion in 2006 to \$8.4 billion in 2011, according to market researcher Displaybank Co. (San Jose, Calif.).

Adding credence to the analog foundry hype are analog integrated-device manufacturers (IDMs). Those manufacturers who have traditionally produced analog chips may start outsourcing production, some say, because making high-voltage devices at 0.18 microns and beyond will be too tough for the analog IDMs to handle at their own fabs.

Then there is a price war. Chinese and Korean analog foundry providers are slashing prices for their services, claim industry observers, further fueling the turmoil of the analog foundry market. Some charge that semiconductor IP theft is at an all-time high in China, causing many analog IC makers to shy away from Chinese providers.

With so many players springing up in the analog foundry business, it's tough to tell who's for real in the mad dash to capitalize on the analog/mixed-signal foundry business.

Overall, the analog chip business fell by 1 percent in 2007, but the sector is expected to rebound by 8 percent in 2008, according to market research firm Databeans (Reno, Nev.). And yet, analog chip makers like Intersil, Linear Technology and others recently reported disappointing results and are forecasting a slowdown.

For some time, many digital-based IDMs have been outsourcing more production to silicon foundries. In contrast, Gartner's Ohr said, many large analog IDMs refuse to go down the outsourcing path, saying they want to protect their IP and keep processes in-house.

To some degree, the shakeout has already begun. X-Fab has acquired fabs from Texas Instruments, Zarlink and ZMD. In 2006, X-Fab acquired the Malaysian foundry, 1st Silicon Sdn. Bhd.

Late last year, ON Semiconductor acquired AMI Semiconductor, which also provides analog/mixed-signal foundry services. And recently, Israel's Tower Semiconductor acquired Jazz Semiconductor, a specialty foundry vendor.

Analog is a huge but fragmented market consisting of four basic areas: catalog components; high-power; high-voltage; and RF. Catalog components include comparators and data converters. High-power consists of fiber-optics devices and related products, while RF is usually associated with wireless.

The current industry buzz focuses on high-voltage, which encompasses several processes, such as high-voltage CMOS and bipolar-CMOS-DMOS (BCD). The attraction of BCD comes from integrating analog circuits (bipolar), logic circuits (CMOS) and high-voltage circuits (DMOS) on the same chip.

The "sweet spot" for the high-voltage market is devices that range from 5 V to 40 V, according to Marco Racanelli, vice president of technology and engineering at Jazz Semiconductor. "The bulk of power-management devices are made at these voltages," he said.

Power management includes battery management ICs, DC-to-DC converters, LED drivers and regulators. Meanwhile, 60-V to 80-V parts tend to go into automotive applications, while 120-V to 150-V devices are geared for power supplies, Racanelli said.

Unlike the digital foundry world, there is no clear-cut leader in the analog foundry sector. But foundry giants IBM and TSMC have recently expanded their analog efforts--a move that could stimulate a market shakeup.

For years, TSMC has offered RF, high-voltage and related processes. Last year, TSMC and Power Analog Microelectronics co-developed a BCD process. TSMC also joined the Interoperable PDK Libraries industry alliance, a group pushing for a standard analog foundry process design kit.

Some believe TSMC presents only a minor threat. TSMC disagrees. "We're doing full-bore analog designs," said Chuck Byers, the company's director of brand management.

Like TSMC, IBM's Microelectronics Group is also making waves. In October, Austriamicrosystems rolled out its 0.18-micron, high-voltage CMOS process. The process, co-developed with IBM, enables the development of power-management, MEMS interface and medical products, according to the companies.

The other wild card is China, where ASMC and BCD Semiconductor have been offering analog/mixed-signal foundry services for some time. Now, two more Chinese players are entering the fray: CSMC Technologies and SMIC.

Chinese companies have gained some share of the analog market by cutting prices, analysts said. China has also gained a nefarious reputation for semiconductor IP theft, according to several analysts. For this reason, many analog IC makers "are afraid of handing over their IP in China," said one observer.

Others take a slightly different view. "Protection of IP for analog and mixed-signal is a totally different kettle of fish from digital," said Danny Lam, an analyst with The Fairview Group (San Ramon, Calif.) "Analog is still extremely difficult to replicate, even if you grind down the chip and copy it. Analog and mixed-signal devices, unlike their digital cousins, cannot be cloned in this fashion."

For some time, SMIC has offered mixed-signal processes, based mainly on proprietary technology for use by a single customer. At a recent event, SMIC rolled out its mixed-signal/analog/RF foundry service for the general market.

By year's end, SMIC claims it will offer a 0.35-micron, BCD-based process with a 40-V specification. In early 2009, it will roll out a similar silicon-on-insulator offering

Another Chinese player CSMC was focused on the digital consumer market, but found that the "cash cow is in analog," said Carolina Ng, CSMC marketing director. In addition, the company rolled out a 0.5-micron BCD process.

China trails rivals in analog, especially in high-voltage technology. Outside China, many vendors are rolling out their 0.18-micron, high-voltage CMOS and BCD processes. The shift to 0.18-micron technology in high-voltage marks a turning point, according to Aabid Husain, vice president of sales and marketing at Dongbu HiTek, a South Korean specialty foundry. Analog IDMs "can't do it" in their own fabs, Husain said.

The big analog IDMs do not necessarily agree with that assertion, but the foundries may have caught up in high-voltage. Dongbu, for instance, surprised the market by rolling out what it claimed was the industry's first 0.18-micron BCD process. The new process supports a wide range of voltages, from 12 V to 60 V.

"High-voltage is the buzz," Husain said. "LED drivers are a big market for us. We think applications like power-over-Ethernet are also coming online."

Dongbu's archrival, Germany's X-Fab Silicon Foundries, recently rolled out its 0.18-micron, high-voltage process that also makes use of an embedded SONOS-based nonvolatile memory. The process is tailored to automotive applications, said Thomas Hartung, X-Fab vice president of sales and marketing. The company is working on another 0.18-micron version for power-management applications, he added.

And now, there's another vendor: Japan's Renesas Technology sold its German subsidiary wafer fab, Renesas Semiconductor Europe. The buyer was Silicon Foundry Holding, founded by two former Renesas managers. The company will operate under the name LFoundry, and specialize in analog and mixed-signal production aimed at the European foundry market.

"While the established players in this segment all work in Europe with 6-inch wafers and geometries of 0.35-micron or larger, we can offer 8-inch wafers and geometries of 0.25-micron, 0.18-micron and even 0.15-micron. Thus, our overall productivity is significantly better," claimed Michael Lehnert, CEO of Silicon Foundry.

See also: [Does the analog foundry model hold water?](#)

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