Pioneering 300
Setting the Pace for Semiconductor Manufacturing

December 12, 2001

Operational Excellence at Infineon Technologies

Dr. Andreas von Zitzewitz
Chief Operating Officer
Operational Excellence at Infineon: The Four Cornerstones

- Flexibility
- Customer Orientation
- Speed
- Productivity
Maximize Manufacturing Flexibility

Flexibility

Customer Orientation

Speed

Productivity
Optimized Manufacturing Flexibility

**Flexibility** = maximize opportunities of upturns / minimize impact of downturns

- **Internal flexibility:** DRAM Cluster, Logic Cluster and flexibility in between
- **External flexibility:** Silicon foundries and subcontractors are important components in Infineon's manufacturing landscape

Loading flexibility
Infineon's Production Capabilities:
A Broad Spectrum from DRAM to Radio Frequency Chips

<table>
<thead>
<tr>
<th>DRAM</th>
<th>Emb. DRAM</th>
<th>Logic CMOS</th>
<th>Analog CMOS</th>
<th>Emb. Flash</th>
<th>RF BiCMOS</th>
<th>Bipolar</th>
<th>SiGe</th>
<th>GaAs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# The Infineon Frontend Manufacturing Network

<table>
<thead>
<tr>
<th>Location</th>
<th>Wafer size actual</th>
<th>Min. feature size in production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hsinchu</td>
<td>8”/ (12”)</td>
<td>0.14µm</td>
</tr>
<tr>
<td>Richmond</td>
<td>8”/ (12”)</td>
<td>0.14µm</td>
</tr>
<tr>
<td>Dresden</td>
<td>8” / 12”</td>
<td>0.14µm</td>
</tr>
<tr>
<td>Essonnes</td>
<td>8”</td>
<td>0.18µm / (0.13µm)</td>
</tr>
<tr>
<td>Singapore</td>
<td>(12”)</td>
<td>(0.13µm)</td>
</tr>
<tr>
<td>Perlach</td>
<td>6”</td>
<td>0.35µm</td>
</tr>
<tr>
<td>Regensburg</td>
<td>6” / 8”</td>
<td>0.35µm</td>
</tr>
<tr>
<td>Villach</td>
<td>5”/ 6”/8”</td>
<td>0.65µm</td>
</tr>
</tbody>
</table>

**Technologies**

- **DRAM**
  - eDRAM
- **Advanced Logic & eFlash**
- **RF**
- **Mixed Signal**
- **Power**
The Infineon Backend Manufacturing Network

- Technologies
  - DRAM eDRAM
  - Discretes & Opto
  - IC & RF
  - Power
  - Fiberoptic
  - Chip Card

- Memory Clusters
  - M
  - E
  - M
  - O
  - R
  - Y

- Corporate Backends
  - M
  - E
  - M
  - O
  - R
  - Y

- Business Units
  - R&D, Pilotline
  - Burgweinting
  - Regensburg
  - Warstein / Cegléd
  - Berlin / Trutnov
  - Singapore
  - Wuxi
  - Malacca
  - Dresden
  - Richmond
  - Porto
The DRAM Fab Cluster

Global process synchronization

Common technological roadmaps

Identical quality

One (virtual) fab to the customer

Frontend-
wafer production

Dresden

Richmond

Hsinchu

Backend-
assembly / test

Dresden

Richmond

Porto

Malacca

DRAM Production Flexibility - A Proven Concept since 1998
Flexibility between DRAM and Logic: An Operational and Strategic Concept

Operational advantages

- DRAM as a forerunner in lithography and advanced tool learning
- DRAM as volume vehicle with excellent debug capabilities to tune and stabilize processes (logistics, equipment + utilization, technologies)
- DRAM production optimizes manufacturing processes - facilitated “break-in” for new manufacturing sites and teams
- Commodity DRAM allow to handle fluctuations in logic IC demand and to fill capacity for maximizing capital efficiency of fabs
Strategic advantages

- Flexible and gradual transfer of production from memory to logic ICs (e.g. fabrication in Dresden, Richmond and Hsinchu)
  - 80% of equipment is common to DRAM and Logic
- Ideal technological position for embedded solutions

### Without eDRAM technology

- Logic part
- SRAM part

### With eDRAM technology

- Logic
- Embedded DRAM

1 Mbit RAM ➔ 20 Mbit RAM
Strategic Partnerships in Technology Development and Frontend Manufacturing

**Partners in the development of leading-edge technologies**

- IBM: Next generation DRAM and magnetoresistive RAM
- Toshiba: Ferroelectric RAM
- IBM and UMC: Advanced CMOS logic
- UMC: embedded flash
- Saifun: Mass storage flash

**Close cooperation with silicon foundries**

- TSMC: Microcontroller
- ZMD: Secure memories for chipcards
- UMC: Advanced CMOS and embedded flash
New Dimension of Partnership with United Microelectronics Corp.

Synchronization of development and manufacturing

- Common development of advanced logic in IBM / Infineon / UMC alliance
- Fully compatible process implementation in Infineon and UMC fabs
- Extensive sharing of design platforms and libraries

UMCi - 300mm logic foundry (JV of Infineon and UMC in Singapore)

- 2001 groundbreaking, 2003 start of operation
- Up to 40,000 wafers per month capacity
- Infineon: 30% equity, up to 37% access of capacity
Uncompromised Speed in Operations

- Flexibility
- Customer Orientation
- Speed
- Productivity
Time-to-Market is Key for Securing Market Share

**Speed in technology and product development**

- Manufacturing management methods implemented in our „Design Fabs“ to accelerate cycle time, throughput, and execution quality
- Reduced roll-out time of leading-edge CMOS technologies through development & manufacturing alliance with UMC
- Technology portfolio re-alignment program to create focus on top projects
- Currently reduced factory utilization is used for accelerated technology and product learning

**Speed in volume ramp and improvement of yield**

- Cluster concept for maximum synergy in yield management
Factory Management for the “Design Fabs”

**Throughput of projects**

<table>
<thead>
<tr>
<th>Quarter</th>
<th>PL 7</th>
<th>PL 6</th>
<th>PL 5</th>
<th>PL 4</th>
<th>PL 3</th>
<th>PL 2</th>
<th>PL 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1-Q1</td>
<td>18</td>
<td>5</td>
<td>13</td>
<td>13</td>
<td>12</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>M1-Q2</td>
<td>13</td>
<td>5</td>
<td>13</td>
<td>13</td>
<td>12</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>M3-Q1</td>
<td>12</td>
<td>11</td>
<td>12</td>
<td>8</td>
<td>12</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>M3-Q2</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>12</td>
<td>10</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>M7-Q1</td>
<td>12</td>
<td>13</td>
<td>13</td>
<td>12</td>
<td>10</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>M7-Q2</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>12</td>
<td>10</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>M9-Q1</td>
<td>12</td>
<td>13</td>
<td>13</td>
<td>12</td>
<td>10</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>M9-Q2</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>12</td>
<td>10</td>
<td>11</td>
<td>4</td>
</tr>
</tbody>
</table>

**Target number of projects in the pipeline**

<table>
<thead>
<tr>
<th>Last milestone reached</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
</tr>
<tr>
<td>10</td>
</tr>
</tbody>
</table>

**Cycle time of product development**

- **Target**
- **CT in Months**

**Throughput capability and cycle time requirements determine target number of projects**
Tuning Critical Elements to Reduce Time-to-Market

**Speed in transfer of processes and synchronization**
- Fast process transfers and alignment is the backbone of our Cluster Concept
- Establishment of an Infineon wide network of process experts to form transfer specific task force teams

**Speed in manufacturing**
- We are prepared to quickly grasp market opportunities
- Speed in manufacturing requires the optimization of procedures within a manufacturing plant
- Currently reduced loading is used to minimize idle-time between physical processing
- Improved speed will be carried over into the next upturn
World Class Productivity

Flexibility

Customer Orientation

Speed

Productivity
Components of Continuous Productivity Increase

- Chip-size shrink at leading-edge of industry
- Cost benefit through head start in 12" technology
- Continuous internal and external benchmarking
- Optimized human and capital asset management
Infineon’s Technology Nodes at Forefront of Industry’s Capability

- **i-line (365nm)**
- KrF (DUV 248nm)
- ArF (193nm)
- F₂ (157nm)

Resolution Enhancement Technologies:
- 0.5µm
- 0.35µm
- 0.25µm
- 0.18µm
- 0.13µm
- 100nm
- 70nm
- 50nm
- 35nm

Next generation Extreme Ultraviolet Lightsources (EUV)
Electron beam direct write etc.
Benefits through Transition to 300 mm Technology

Overall manufacturing cost per chip: 0.7X

Relative increase of wafer area
Wafer area 2.25X
number of chips 2.5X
Wafer production cost 1.8X (cleanroom, equipment, materials)

Overall manufacturing cost per chip: 0.7X

Year of introduction (> 1 Mio / year)

Year of introduction

Relative increase of wafer area
0 0,5 1 1,5 2 2,5

50 (19,6) 75 (44,2) 100 (78,5) 125 (122,5) 150 (176,7) 200 (314,1) 300 (706,8)
Maximum Potential and Flexibility in 300 mm Production

- Perfectly positioned for the next growth cycle
- Access to 4 fab modules
- Cost reduction per chip $\geq 30\%$
- DRAM ramp with 256 Mbit in 0.14 $\mu$m technology
- Advanced logic production in Cu and 0.13 $\mu$m / 0.10 $\mu$m in 2003
Backend Benchmarking: Example of Productivity Leadership

- **Material Eff. in rel. Units**
  - Infineon
  - Competitor A
  - Competitor N
  - Competitor P

- **Personnel Eff. in rel. Units**
  - Infineon
  - Competitor A
  - Competitor N
  - Competitor P

- **Capital Eff. in rel. Units**
  - Infineon
  - Competitor A
  - Competitor N
  - Competitor P
Our world-wide workforce is our greatest asset!

- Infineon offers and encourages career perspectives on a global scale
- Technical Ladder Program aims at world-class technical excellence
- Infineon’s Job Rotation Program enhances knowledge exchange and best practice sharing

Smart and critical usage of capital assets

- Infineon wide equipment planning and exchange system
- New Infineon wide procedure to maximize return of investment
Customer Orientation

- Flexibility
- Customer Orientation
- Speed
- Productivity
Customer Orientation is Our Central Focus

Customer orientation in speed and reliability
- Uncompromised timely provision of samples and volume output
- Further refinement of Local Distribution Centers and Electronic Tracking System
- Target is 100% on-time-delivery and fulfillment of logistical commitments

Customer orientation in quality and style
- Infineon wide quality enforcement and qualification procedure
- Customer Satisfaction Survey as the ultimate check-point of performance
- We want to achieve top supplier ranking at our key accounts
- We focus our energies to outperform our competitors!