Orio Bellezza
President
Technology, Manufacturing and Quality

Manufacturing Strategy

Integrated internal manufacturing and R&D on differentiated technologies and packages
Partnership with foundry and OSAT for standard technologies and packages as well as advanced FinFET CMOS
Offer our customers multiple sources and integrated supply chain control

- SiC and GaN technologies
- 300mm wafer fabs strategy for high volume differentiated technologies
- Power Modules
- Outsourcing

Front-End
Back-End
Key Programs

Silicon Carbide
150mm capacity expansion
Vertical integration of substrate supply chain

Gallium Nitride
150mm investment for RF for 5G
Installing 200mm pilot line in Tours for Power Discretes

Power Modules
Vertically integrated internal manufacturing,
Si and SiC capability, multiple sources planned

300mm Strategy
New fab in Agrate to support growth in Smart Power, PMOS
and IGBT beyond 2021

Vertical integration of substrate supply chain

Modular expansion of Crolles300, in specialized imaging,
FD-SOI 28nm, RF mixed signal and embedded-NVM

Partnerships with Foundries and OSATs
Increase the number of technologies qualified in outsourcing,
targeting 30% Front-End in foundries
and >30% back-end in subcontracting

Silicon Carbide Manufacturing

- 150mm in volumes in Catania since 2017
  - Automotive grade Power MOSFET and Diodes
  - Yields and quality at industry standard
  - Second source planned
- Committed to invest for growth - capacity expansion almost 3X in 2019 versus 2017
- Integrated teams of Design, R&D and Fab to support technology development and prototyping
- Secured supply of SiC substrates for future growth

Normalized capacity evolution

Catania
150mm SiC
SiC Manufacturing Strategy

<table>
<thead>
<tr>
<th>Device Manufacturing</th>
<th></th>
<th>2021 Additions</th>
<th>Beyond 2021</th>
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</thead>
<tbody>
<tr>
<td>Power MOSFET Technology</td>
<td>Gen2/Gen3 (planar)</td>
<td>Gen4 (trench)</td>
<td>Next Generation</td>
</tr>
<tr>
<td>Front-End fabs</td>
<td>Catania 150mm</td>
<td>Asia 2nd fab 150mm</td>
<td>Evolution to 200mm</td>
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<tr>
<td>Back-End plants</td>
<td>Shenzhen</td>
<td>Asia 2nd plant</td>
<td>Evolution to 200mm</td>
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<tr>
<th>Substrate Supply</th>
<th></th>
<th>2021 Additions</th>
<th>Beyond 2021</th>
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<tr>
<td>External Qualified suppliers</td>
<td>4 qualified suppliers</td>
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<tr>
<td>External Supply agreements</td>
<td>LTSA with CREE</td>
<td>Enlarge base</td>
<td></td>
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<tr>
<td>Internal</td>
<td>Norstel technology development &amp; integration</td>
<td>Internal supply 150mm</td>
<td>Evolution to 200mm</td>
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Gallium Nitride

- **RF GaN-on-Silicon** production line in Catania
  - Technology under development, production maturity by end 2019
  - Wafer fab capacity 150mm investment under installation, volume ramp up in 2020
  - Plan to expand in 200mm to support technology roadmap and volume growth starting in 2021

- **GaN for Power Conversion** applications
  - Pilot line under construction in Tours in 200mm, active in H2 2020
  - First volume production start planned by 2021
  - Partnership with CEA LETI for Diodes and Transistor technology development
Power Module Manufacturing

- Development competence center and prototyping capability in Catania
- Internal production capacity in Asia, supporting standard and customized solutions
- External source active

300mm Strategy

Establish 300mm Cluster “Agrate + Crolles + Silicon Foundries”

<table>
<thead>
<tr>
<th>Specific Technology Mission</th>
<th>Common manufacturing base for flexibility</th>
<th>Specific Technology Mission</th>
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<tr>
<td><strong>Crolles 300mm</strong></td>
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<tr>
<td>• Specialized Image Sensors</td>
<td>• RF and Analog Mixed signal (130/90nm)</td>
<td>• Advanced Smart Power (BCD)</td>
</tr>
<tr>
<td>• 28nm FD-SOI &amp; derivatives</td>
<td>• Embedded-NVM (90/40nm)</td>
<td>• Advanced Power MOS &amp; IGBT</td>
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<tr>
<td>• RF and Analog Mixed signal (≤ 65nm)</td>
<td></td>
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<tr>
<td>• Embedded-NVM (&lt;28nm)</td>
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<tr>
<th>Silicon Foundries</th>
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<tr>
<td>• Embedded-NVM (90/40nm)</td>
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<tr>
<td>• 28nm FD-SOI</td>
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<tr>
<td>• FinFET 16/7/5nm</td>
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### Agrate 300mm

**Smart Power & Power Fab**

**Mission and Size**
- Development and manufacturing of Smart Power (BCD), Power MOS and IGBT
- About 68,000 m² total covered building space
- About 13,000 m² total clean room, at full build out

**Status and Planning**
- Development and first industrial deployment phase:
  - Start of construction: H2 2018
  - Ready for equipment in: H2 2020
  - Wafers out: H1 2021
  - High volume manufacturing start >2021
  - Modular expansion of facilities and clean room, tuned to market demand

**Agrate-Crolles preparation tasks**
- Several workstreams in place (facilities, equipment, automation…)
- BCD and IGBT process modules scale from 200 to 300mm, speeding learning curve & qualification
Foundries Strategy

- Targeting to increase from ~20% to ~30% of total production value
- Extending the number of technologies in outsourcing

<table>
<thead>
<tr>
<th>Technology</th>
<th>Sources</th>
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<tbody>
<tr>
<td>eNVM 180nm</td>
<td>Foundry</td>
</tr>
<tr>
<td>eNVM 90nm</td>
<td>Crolles, Rousset</td>
</tr>
<tr>
<td>eNVM 40nm</td>
<td>Crolles</td>
</tr>
<tr>
<td>CMOS FD-SOI</td>
<td>Crolles 300</td>
</tr>
<tr>
<td>FinFET 16/7/5nm</td>
<td>Foundry</td>
</tr>
<tr>
<td>Power MOS LV</td>
<td>Catania, Singapore</td>
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<tr>
<td>IGBT</td>
<td>Catania, Singapore</td>
</tr>
<tr>
<td>BCD 160nm</td>
<td>Agrate</td>
</tr>
<tr>
<td>Analog CMOS 130nm</td>
<td>Crolles</td>
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</tbody>
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- Qualification on-going: ➡️
- Active: ➡️

2019 Capital Spending

- Mix change, R&D, others
  - Smart power evolution to BCD9/9 for automotive and industrial
  - Technology development
  - Fab automation, quality, digitalization, equipment obsolescence

- Strategic initiatives
  - SiC 150mm in Catania
  - Agrate 300mm buildings
  - GaN in Catania and Tours
  - Specialized imaging in Crolles300

- Capacity growth
  - Power MOS/IGBT in Singapore
  - 28nm FD-SOI in Crolles300
  - Singapore fab acquisition
  - Assembly and Test

- $1.1B to $1.2B
### Takeaways

Manufacturing is a key enabler to achieve our strategic objectives in balanced make-or-buy strategy.

2019 Capital investment plan supports both ongoing business and strategic programs.

**Key programs focus**

- SiC growth and vertical integration entering GaN production
- 300mm fab construction in Agrate
- Power modules ramp up
- Increase foundries technology base