CMP User’s meeting 2017

ams Full Service Foundry division

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January 26, 2017
## AMS OVERVIEW & UPDATES

- 0.18UM PROCESSES
- 0.30UM SUPER LOW NOISE HV PROCESS (A30)
- FOUNDRY OPTOELECTRONIC PLATFORM
- FOUNDRY ECOSYSTEM
Our business

- Focus on high performance sensor solutions
- Sensor solutions, sensor ICs, interfaces, related software
- Small, low power, highest sensitivity, multi-sensor integration
- Full service foundry including packaging and testing options

Our end markets

- Consumer & Communications (C&C) – 50% of sales H1 2016
- Automotive, Industrial, Medical (AIM) – 50% of sales H1 2016

By the numbers

- 700+ ams engineers (830+ combined with Heptagon)
- 18+1 design centers, 2+1 manufacturing locations
- 35 years of design and manufacturing know-how
- 2,100+ ams employees worldwide (2,900+ combined with Heptagon)
- 8,000+ customers
The ams world of sensors

Smart Phones & Tablet
- Ambient light, color & proximity sensors
- Active Noise Cancellation
- Breath analysis
- Gesture recognition
- Environmental sensors
- Spectral sensors

Wearables
- Biosensors, heart rate monitoring
- Active Noise Cancellation
- Environmental sensors
- Ambient light, color sensing
- Power management

Smart Home & Buildings
- Air quality sensors
- Flow sensors
- Gas sensors
- Humidity sensors
- Smart light sensors
- Temperature sensors

Automotive
- Air quality sensors
- Position sensors
- Sensors for advanced driver assistance

Industrial
- CMOS sensors for machine vision and drones
- Flow sensors
- Industrial/building automation
- NFC/RFID Sensor Tags
- Position sensors

Medical
- CMOS image sensors and miniature cameras for endoscopy
- Image Sensors for:
  - Computed tomography
  - Digital x-ray
  - Surgical robots
Full service foundry
Your one-stop-shop for turn-key high performance analog IC solutions

Specialty processes
- 0.18µm, 0.35µm, 0.8µm
- CMOS, HV, SiGe
- AUT & MED certified
- Extended temp range

Foundry services
- MPW & MLR service
- Benchmark PDK: hitkit
- Highly accurate models
- Digital & analog base IP

Turn-key solutions
- One-stop-shop
- Mixed-signal test
- Qualification services
- 2nd source capabilities

More than silicon
- Customized solutions
- 3D IC using TSVs
- Extended IP portfolio
- Advanced packages
## Status of 0.18µm processes

<table>
<thead>
<tr>
<th>Technology</th>
<th>C18</th>
<th>H18</th>
</tr>
</thead>
<tbody>
<tr>
<td>status</td>
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</tr>
<tr>
<td>hitkit v4.11</td>
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<td>design documents</td>
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<td>MPW runs</td>
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<tr>
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<td>mass prod</td>
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<tr>
<th>Technology</th>
<th>C18</th>
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<th>aC18</th>
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<th>aH18</th>
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<td>status</td>
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<td>cond. released</td>
<td>May 2017</td>
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<td>v4.11</td>
<td>v4.14 released</td>
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<tr>
<td>design documents</td>
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<td>released</td>
<td>released</td>
<td>prel. docs on demand</td>
</tr>
<tr>
<td>MPW runs</td>
<td>on demand</td>
<td>on demand</td>
<td>4 runs in 2017</td>
<td>4 runs in 2017</td>
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<tr>
<td>SDT runs</td>
<td>available</td>
<td>available</td>
<td>available</td>
<td>accepted</td>
</tr>
<tr>
<td>production</td>
<td>mass prod</td>
<td>mass prod</td>
<td>ramp up</td>
<td>N.A.</td>
</tr>
</tbody>
</table>

→ All information available on foundry support server!

→ Please contact hitkit@ams.com
C18/H18 vs. aC18/aH18 process

Process migration

**Device:**
- Not all devices are available at ams
- BE stack different (CU vs. AL, FT, AM)
- Different models / corners
- HV oxide not available
- New IOLIBs

**Action:**
- re-simulate / replace
- redesign
- re-simulate
- redesign
- redesign

→ Migration guidelines and support available for foundry customers

→ Please contact hitkit@ams.com
CMP USER’S MEETING 2017
2017-01-26, Paris

AMS OVERVIEW & UPDATES
0.18UM PROCESSES
0.30UM SUPER LOW NOISE HV PROCESS (A30)
FOUNDRY OPTOELECTRONIC PLATFORM
FOUNDRY ECOSYSTEM
A30 – 0.30µm Analog Low Noise CMOS process
High performance CMOS process optimized for ultra low noise applications

Technology highlights
• based on industry proven 0.35µm High-Voltage CMOS process
• realized as an optical shrink by a factor of 0.9 from H35
• 3 and 4 metal layers, optional thick top metal 4 available

Extensive set of high quality devices:
• Optimized super low noise device NMOSISLN (noise: 0.46 pA/√Hz)
• Isolated HV NMOSI20T device
• Floating 3.3V NMOS/PMOS (std. $V_T$ and low $V_T$)
• Vertical bipolar devices VERTN1/VERTPH
• Several capacitors (poly, sandwich, MOS varactor)
• Several resistors (poly, high-res poly, precision poly, diffusion, well)

Advantages & benefits:
• Superior noise performance
• Smaller die size / more dies per wafer
• High yield: Running in mass production (billions of devices shipped)
# Applications & Markets

**A30 HPA Low Noise CMOS Process**

<table>
<thead>
<tr>
<th>Market</th>
<th>Application</th>
<th>Device Features &amp; Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical</td>
<td>Hearing Aid</td>
<td>Audio signal (amplifier), Noise cancelling</td>
</tr>
<tr>
<td>Medical</td>
<td>Neural Recording</td>
<td>Low Noise Amplifier</td>
</tr>
<tr>
<td>Consumer</td>
<td>Mobile ANC</td>
<td>Headsets, MEMS Micro Amplifier</td>
</tr>
<tr>
<td>Automotive</td>
<td>ANC</td>
<td>Cabin Noise Cancelling</td>
</tr>
</tbody>
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## AMS OVERVIEW & UPDATES

### 0.18UM PROCESSES

### 0.30UM SUPER LOW NOISE HV PROCESS (A30)

### FOUNDRY OPTOELECTRONIC PLATFORM

### FOUNDRY ECOSYSTEM
# Foundry Optoelectronic Platform

## Front end

**Photo Diodes**
- n-well
- p-n
- n-p
- PIN

**Wafer starting materials**
- 14µm EPI, Bulk (14-24 Ω cm)
- 20, 40, 60µm iEPI (400-1000 Ω cm)

**Processes**
- C35 opto
- H35 opto

## Back end

**Anti-Reflective Coatings**
- TopARC
- BARC
- eBARC

**Optical Filters**
- Interference
- RGB

**Optical Packages**
- ODFN
- 3D-WLCSP

**Electrical / optical test**
- Wafer probe test / Final test

## Sensor development

**Customer Support**
- Sensor development service
### Photo Diodes / Examples

<table>
<thead>
<tr>
<th>Standard Opto Process</th>
<th>QE [%]</th>
<th>Responsivity [A/W] (typ@850nm)</th>
<th>Dark Area Current [nA] normalized for 150<em>150µm²/125</em></th>
<th>Capacitance [pF] normalized for 150*150µm² PD</th>
</tr>
</thead>
<tbody>
<tr>
<td>NWELL (EPI+ARC)</td>
<td></td>
<td>0,33</td>
<td></td>
<td>2,4</td>
</tr>
<tr>
<td>NWELL (EPI+BARC)</td>
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<td>0,42</td>
<td></td>
<td>2,4</td>
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<tr>
<td>NWELL (NON EPI+ARC)</td>
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<td>0,5</td>
<td></td>
<td>2,5</td>
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<tr>
<td>NWELL (NON EPI+BARC)</td>
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<td>0,57</td>
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<td>2,5</td>
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<table>
<thead>
<tr>
<th>Adv. Opto Processes</th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PIN diode CMOS (isolated from</td>
<td></td>
<td>0,51</td>
<td></td>
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</table>

N-well and PIN photo diodes with different performances in responsivity, dark current and capacities depending on wafer material, ARC or BARC.
Shaping the world with sensor solutions
Advanced analog & mixed-signal semiconductor ecosystem

PDK
- HD Digital libraries
- IO cells incl ESD protection structures
- Verification rule decks (DRC, LVS, ERC, PEX, ..)
- Various tools: SOAC, LTACC

IPs & Advanced IPs
- ADCs & DACs
- Bandgaps
- RAMs & ROMS
- OTPs & EEPROM blocks

Consulting Services & Support
- Design Support
- ESD support
- Place & Route

Turnkey Solutions
- Test program & hardware development
- Wafer sort & final test
- Assembly services

3rd Party IP Blocks
- LDOs, Oscillators, PLLs
- ADCs & DACs
- Custom IP block development

Design Resources
- Block level design
- Complete IC design

Product Qualification
- HTOL & HAST
- APQP
- PPAP

3D-IC technologies
- Through Silicon Vias (TSV)
- Wafer to wafer bonding
- Die to wafer stacking

EDA Tool Support
- Access to 3rd party PDKs
- EDA tool service
Thank you

Please visit our website www.ams.com