Evercore ISI AutoTech & AI Forum

KLA Opportunities in Automotive

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KLA Corporation

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Disclaimer

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KLA at a Glance

- Founded in 1976
- Headquarters in Milpitas, CA
- ~14,000 Employees
- $10.5B CY22 Revenue
- >65% PhD/Master’s among professional roles

Diversified Leader in the Electronics Ecosystem
KLA’s Presence in the Electronics Manufacturing Ecosystem

- SUBSTRATES
- CHIPS
- WAFER-LEVEL PACKAGING
- COMPONENTS
- PRINTED CIRCUIT BOARD
- FLAT PANEL DISPLAY

AUTOMOTIVE
CONNECTED DEVICES
MOBILE DEVICES
5G INFRASTRUCTURE
DATA
Automotive Electronics
The Automotive Industry is Being Transformed...

**Chip Shortage**
- Just-in-time to just-in-case
- Strategic supply agreements and direct fab investments

**Software-Defined Vehicles**
- >80% of innovation enabled by semiconductors
- OEMs working directly with chip companies
- Subscription services

**Electrification**
- New platforms and factories
- Batteries, inverters and power semiconductors

**Driver Assistance**
- Sensor proliferation and domain controllers
- Leading-edge CPU/GPU, memory

New entrants | New requirements | New partnerships
... Driving Broad-based Demand for Semiconductors

**Strong Growth**

Auto Semi Forecast ($Billion)$

<table>
<thead>
<tr>
<th>Year</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
<th>2026</th>
<th>2027</th>
<th>2028</th>
<th>2029</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>$63</td>
<td>$74</td>
<td>$82</td>
<td>$88</td>
<td>$95</td>
<td>$103</td>
<td>$110</td>
<td>$116</td>
</tr>
</tbody>
</table>

**All Device Types**

- Processors 4%
- Memory 9%
- Photonics 9%
- Power 34%
- Sensors/MEMS 13%
- MCU 15%
- Analog 7%
- RF 2%
- ASIC 7%

**All Design Rules**

- 15 new fabs $≥ 350nm
- 6 new fabs 110-250nm
- 4 new fabs 28-90nm
- 7 new fabs ≤ 16nm

**Incremental Automotive Fab Capacity Needed by 2027 (WSPM)**

- 370,333

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1Source: IHS, Cowen and Company
2Source: Yole- 2021 breakdown
3Source: Yole, others. 25k WSPM typical automotive fab size
... and Changing Automotive Fab Profiles

### Mature DR Fabs
- 200nm fab equipment refresh
- New 300mm large DR fabs

### Power Semiconductor Fabs
- SiC and GaN
- 300mm IGBT

### Advanced DR Fabs
- ‘Zero Defect’ methods
- Back-fill leading edge fabs

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![Image: IGBT = insulated gate bipolar transistor](image)

Changing landscape provides new diversified opportunities for KLA
Automotive at KLA
Automotive at KLA

37%  
KLA Auto System Revenue CAGR¹

11%  
KLA Auto Service Revenue CAGR²

>3x  
KLA vs. Total Auto Semi CAGR²

>$300M  
Power SiC Revenue in 2022

>35%  
Auto % of SPTS Revenue in 2022

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1 KLA Auto Semi CAGR 2017-2023F
2 Combined KLA System + Service revenue (30%) vs. IHS/Cowen total auto semi (8.8%), 2017-2023F
Enabling Zero Defect
Potential Reliability Defects Must Be Found to Meet Quality Goals

- Hard killer defects in a test coverage gap
- Function of yield and test coverage

- Become activated some time after test
- Usually requires statistical approach
Dedicated Automotive Inspection Products Launched in 2021

Modern auto-specific portfolio provides capability, capacity and extendibility
I-PAT® Inline Defect Screening: Leveraging AI to Reduce Risks

Each die is scored based on aggregate defectivity.
Enabling Silicon Carbide (SiC)
SiC has significant Cost Issues

Typical Yield by Step\(^1\)

<table>
<thead>
<tr>
<th>Step</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substrate and Epitaxy Yield</td>
<td>65%</td>
</tr>
<tr>
<td>Device Fab – Wafer Yield (Scrap)</td>
<td>92%</td>
</tr>
<tr>
<td>Device Fab – Probe Yield</td>
<td>80%</td>
</tr>
<tr>
<td>Dicing Yield</td>
<td>98%</td>
</tr>
<tr>
<td>Packaging Yield</td>
<td>99%</td>
</tr>
<tr>
<td>Final Test / Burn-in Yield</td>
<td>97%</td>
</tr>
</tbody>
</table>

Overall Yield < 50%

$\text{SiC} \rightarrow \text{Si IGBT}; 3x$

Cost

Reliability

Escapes = f (yield, test coverage)\(^3\)

Significant Cost Increase due to substrate immaturity and device yield issues

\(^1\)SiC yield and cost are typical values (2023), compiled from Yole, JP Morgan, PGC Consultants, KLA data, and other sources. Large variation from fab-to-fab.

\(^2\)At equivalent performance for EV traction inverter mission profile compared to comparable Si IGBT device.

\(^3\)See, for example, Williams-Brown or Seth-Agrawal test escape models
SiC at KLA

Proven Solutions

Soitec boosts customer yield of Silicon Carbide semiconductor manufacturing with KLA inspection technology

Soitec boosts customer yield of Silicon Carbide semiconductor manufacturing with KLA inspection technology

Bormin (Grenoble), France, July 13th, 2022 - Soitec (Euronext Paris), an industry leader in designing and manufacturing innovative semiconductor materials, has selected KLA Corporation (NASDAQ: KLAC), a leader in process control and advanced inspection systems, to enable high yield manufacturing of innovative Silicon Carbide (SiC) devices for the automotive industry.

Soitec leverages its unique and patented SmartSiC™ technology to produce SiC substrates, which aim to improve the performance of power electronics devices and boost electric vehicles’ energy efficiency.

Based on its track record of using KLA’s inspectors for its Silicon-on-Insulator (SOI) wafers, Soitec has extended its partnership with KLA and selected the Surfscan® SP A2 unpatterned inspection system for its SmartSiC™ wafers.

Soitec’s SmartSiC™ wafers provide superior and unique crystal quality, while KLA’s Surfscan® SP A2 leverages DIUV optics and advanced algorithms to support substrate quality control. This partnership will enable SiC substrate production at new and even more sophisticated levels, supporting the industry to bring high quality SiC semiconductors in high volumes to the automotive market.

Highlights from KLA’s SiC Portfolio

Process

- plasma etch
- plasma dicing
- PECVD
- PVD

Inspection

inspection solutions for substrate/epitaxy, patterned wafer and inline defect screening

Metrology

metrology solutions for wafer shape, films, overlay, CD, implant and analytics
KLA Solutions are Central to SiC Cost Reduction

**Objectives**
- More functioning die per wafer
- Better performance and power density (Amps/mm²)
- Lower substrate costs
- Fewer defects

**Substrate Innovation**
- Engineered SiC substrates
- Novel wafering processes
- SiC growth technologies

**Technology Migration**
- 1.8x more die per wafer

**Substrate/epi inspection | Product wafer inspection | Metrology | Unit process development**
Summary
Automotive is a Growth Engine Across the Entire Company

Announcing IMEC & KLA STAR Consortium

Semiconductor Talent and Automotive Research

- Research for electrification and autonomous reliability
- Connecting automotive ecosystem and research institutions
- Training future talent
- Global partnership with regional execution
- Europe
- Michigan, U.S.
- Japan
MOU Signing with Founding Partners
Summary

The automotive industry has been forever changed by the chip shortage, vehicle electrification and the software-defined vehicle.

KLA works closely with the automotive ecosystem to develop a comprehensive portfolio of process control solutions.

The rise of SiC power semi devices poses additional yield, reliability, and cost challenges.

Inline defect screening is being adopted by automotive fabs to reduce escapes for reliability sensitive devices.