# Table of Contents

## Overview / Introduction
- Executive Summary 1
- Reverse Costing Methodology 4

## Technology & Market
- 1200V Si IGBT 5
- 1200V SiC MOSFET 8

## Company profile
- Infineon 41
- STMicroelectronics 41
- Fuji 41
- ONSemiconductors 41
- Mitsubishi 41
- Rohm 41
- Wolfspeed 41
- Littelfuse 41

## Physical Analysis
- 1200V Si IGBT
  - Infineon
  - STMicroelectronics
  - Fuji
  - ONSemiconductors
  - Mitsubishi
  - Rohm
  - Wolfspeed
  - Littelfuse

## Transistor Manufacturing Process
- 1200V SiC MOSFET
  - Wolfspeed
  - Rohm
  - STMicroelectronics
  - Littelfuse
  - Infineon

## Cost & Price Analysis
- Summary of the cost analysis 181
- Yields Explanation & Hypotheses 181
- 1200V Si IGBT
  - Infineon
  - STMicroelectronics
  - Fuji
  - Littelfuse
  - ONSemiconductors
  - Mitsubishi

## Feedback
- System Plus Consulting services 227

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Si and SiC Cohabitation

<200 600 900 1200 1700 3300 >6500

Si Transistors

SiC Transistors

Subject of the report

Overview / Introduction
Technology & Market
- Si IGBT
- SiC MOSFET
Company Profile & Supply Chain
Physical Analysis
Manufacturing Process Flow
Cost & Price Analysis
Related Reports
About System Plus

Low Voltage
- PFC/Power supply
- Audio amplifier

Medium Voltage
- PV Inverter
- Motor Control
- UPS
- EV/HEV

High Voltage
- Wind Mills
- Ship/Cargo
- Rail
- Smart grid

Voltagess (V)
### 1200V Analyzed Devices

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>IGBT</th>
<th>Year</th>
<th>Techno</th>
<th>Current @ 100°C</th>
<th>Die area mm²</th>
<th>Current density A/mm²</th>
<th>Vce sat</th>
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</thead>
<tbody>
<tr>
<td>Infineon</td>
<td>IHW40N120R3</td>
<td>2012</td>
<td>FS trench</td>
<td>40</td>
<td>xxx</td>
<td>xxx</td>
<td>1.55</td>
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<td>Infineon</td>
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<td>FS trench</td>
<td>100</td>
<td>xxx</td>
<td>xxx</td>
<td>1.75</td>
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<td>planar</td>
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<td>Infineon</td>
<td>IRG7PH456UD-EP</td>
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<td>FS trench</td>
<td>57</td>
<td>xxx</td>
<td>xxx</td>
<td>1.7</td>
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<td>STMicro</td>
<td>STGW40H120DF2</td>
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<td>FS trench</td>
<td>40</td>
<td>xxx</td>
<td>xxx</td>
<td>2.1</td>
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<td>STMicro</td>
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<td>FS trench</td>
<td>40</td>
<td>xxx</td>
<td>xxx</td>
<td>1.65</td>
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<td>Fuji</td>
<td>FGW40N120HD</td>
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<td>FS trench</td>
<td>40</td>
<td>xxx</td>
<td>xxx</td>
<td>1.8</td>
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<td>Littelfuse</td>
<td>IXGP30N120B3</td>
<td>2004</td>
<td>PT planar</td>
<td>30</td>
<td>xxx</td>
<td>xxx</td>
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<td>Littelfuse</td>
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<td>PT planar</td>
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<td>xxx</td>
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<td>NPT</td>
<td>95</td>
<td>xxx</td>
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<td>Mitsubishi</td>
<td>CM450DY-24S</td>
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<td>CSTBT</td>
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<td>ON Semi</td>
<td>FGH40N120ANTU</td>
<td>2006</td>
<td>NPT</td>
<td>40</td>
<td>xxx</td>
<td>xxx</td>
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<td>ON Semi</td>
<td>NGTB25N120FL2WAG</td>
<td>2016</td>
<td>FS trench</td>
<td>25</td>
<td>xxx</td>
<td>xxx</td>
<td>2</td>
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<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>SiC MOSFET</th>
<th>Year</th>
<th>Techno</th>
<th>Id (A) @ 100°C</th>
<th>Die area</th>
<th>Current density</th>
<th>Rdson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wolfspeed/Cree</td>
<td>CMF20120</td>
<td>2011</td>
<td>Gen 1 planar</td>
<td>24</td>
<td>xxx</td>
<td>xxx</td>
<td>0.08 ohm</td>
</tr>
<tr>
<td>Wolfspeed</td>
<td>C2M0080120D</td>
<td>2015</td>
<td>Gen 2 planar</td>
<td>24</td>
<td>xxx</td>
<td>xxx</td>
<td>0.08 ohm</td>
</tr>
<tr>
<td>Rohm</td>
<td>SCH2080KE</td>
<td>2012</td>
<td>Gen 2 planar</td>
<td>28</td>
<td>xxx</td>
<td>xxx</td>
<td>0.08 ohm</td>
</tr>
<tr>
<td>Rohm</td>
<td>BSM180D12P3C007</td>
<td>2016</td>
<td>Gen 3 trench</td>
<td>36</td>
<td>xxx</td>
<td>xxx</td>
<td>0.06 ohm</td>
</tr>
<tr>
<td>ST Microelectronics</td>
<td>STC30120</td>
<td>2012</td>
<td>Gen 1 planar</td>
<td>34</td>
<td>xxx</td>
<td>xxx</td>
<td>0.06 ohm</td>
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<tr>
<td>Littelfuse</td>
<td>LSC1MO120E0080</td>
<td>2017</td>
<td>Gen 1 planar</td>
<td>25</td>
<td>xxx</td>
<td>xxx</td>
<td>0.023 ohm</td>
</tr>
<tr>
<td>Infineon</td>
<td>DF11MR12W1M1</td>
<td>2016</td>
<td>Gen 1 trench</td>
<td>50</td>
<td>xxx</td>
<td>xxx</td>
<td>0.023 ohm</td>
</tr>
</tbody>
</table>
Identified SiC Discrete Transistors

SiC Discrete Transistors Benchmark

Available products

Values based on Datasheet
IHW40N120R3

- The package type is a TO247
- Package size: 15.7mm x 20.8mm x 4.83mm
- Pin pitch: 5.44mm
- The package markings include the following markings:
  - H40R1203
  - HAE530

The component is composed by a monolithic IGBT.
• Trench depth: xxx μm
Die transistor

Die cross section

Physical Analysis
- 1200V Si IGBT
  - Infineon
  - STMicroelectronics
  - FUJI
  - Littelfuse
  - Mitsubishi
  - ON Semiconductors

- SiC MOSFET
  - Wolfspeed
  - Rohm
  - ST Microelectronics
  - Littelfuse
  - Infineon

Manufacturing Process Flow

Cost & Price Analysis

Related Reports

About System Plus
Rohm Analysed Devices

<table>
<thead>
<tr>
<th>SiC die</th>
<th>Voltage breakdown</th>
<th>Current @ 100°C</th>
<th>Die area</th>
<th>Current density</th>
<th>Rdson</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCT2080KE</td>
<td>1200V</td>
<td>28 A</td>
<td>xxx mm²</td>
<td>xxx A/mm²</td>
<td>xxx ohm</td>
</tr>
<tr>
<td>BSM180D12P3C007</td>
<td>1200 V</td>
<td>36 A</td>
<td>xxx mm²</td>
<td>xxx A/mm²</td>
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</tbody>
</table>

1200V 40A Planar Mosfet

1200V 36A Trench Mosfet

<table>
<thead>
<tr>
<th>MOSFET</th>
<th>Voltage breakdown</th>
<th>Current at 100°C</th>
<th>Die area</th>
<th>Epitaxy depth</th>
<th>Pitch Width</th>
<th>Wafer Cost</th>
<th>Die cost</th>
<th>Wafer cost (silicon level)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCT2080KE</td>
<td>1200V</td>
<td>28 A</td>
<td>xxx mm²</td>
<td>xxx µm</td>
<td>xxx µm</td>
<td>$ xxx</td>
<td>$ xxx</td>
<td>$xxx</td>
</tr>
<tr>
<td>BSM180D12P3C007</td>
<td>1200 V</td>
<td>36 A</td>
<td>xxx mm²</td>
<td>xxx µm</td>
<td>xxx µm</td>
<td>$ xxx</td>
<td>$ xxx</td>
<td>$xxx</td>
</tr>
</tbody>
</table>
Si IGBT Front-End Cost

The front-end cost ranges from $xxxx to $xxx according to years.

The main part of the wafer cost in 2018 is due to the xxxx (xxx%).
SiC MOSFET Die Cost

The MOSFET die cost ranges from $xxxx to $xxxx according to years.

The Front-end manufacturing represents xxxx of the component cost in 2018.

Probe test, dicing and scrap account for xxxx of the component cost.
Estimated Manufacturer Price

<table>
<thead>
<tr>
<th>Gross Margin</th>
<th>39.0%</th>
</tr>
</thead>
</table>

The module manufacturing cost ranges from $xxx to $xxx according to years.

By taking into account a gross margin of 39% for ST (2017 results), the module manufacturer price is estimated to range from $xxxx to $xxxxx according to years.
Comparison between ST, Cree and Rohm 1200V SiC MOSFET

<table>
<thead>
<tr>
<th>MOSFET</th>
<th>Voltage breakdown</th>
<th>Current at 25°C</th>
<th>Wafer size</th>
<th>Die area</th>
<th>Pitch</th>
<th>Current density A/mm²</th>
<th>Rdson</th>
<th>Qg</th>
<th>FOM ohm•nC</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSIC1MO120E0080</td>
<td>1200V</td>
<td>39A</td>
<td>xxxmm</td>
<td>xxx mm²</td>
<td>xx µm</td>
<td>xxx</td>
<td>0.08</td>
<td>xxnC</td>
<td>xxx</td>
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<tr>
<td>C2M0080120D</td>
<td>1200V</td>
<td>36A</td>
<td>xxxmm</td>
<td>xxx mm²</td>
<td>xx µm</td>
<td>xxx</td>
<td>0.04</td>
<td>xxnC</td>
<td>xxx</td>
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<tr>
<td>SCT30N120</td>
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<td>45A</td>
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<td>xx µm</td>
<td>xxx</td>
<td>0.09</td>
<td>xxnC</td>
<td>xxx</td>
</tr>
</tbody>
</table>

Related Reports
- Comparison between ST, Cree and Rohm 1200V SiC MOSFET
Related Reports

Overview / Introduction
Technology & Market
Company Profile & Supply Chain
Physical Analysis
Manufacturing Process Flow
Cost & Price Analysis
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(>130 analyses per year)

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(>40 reports per year)

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LED
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Imaging
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System

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