## Microchip SiC experience

<table>
<thead>
<tr>
<th>Product Family</th>
<th>Product Packages</th>
<th>Sub Product Family</th>
<th>Key Differentiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate Drivers</td>
<td></td>
<td>• Gate Driver ICs</td>
<td>• Only Digital Programmable Gate Drivers for SiC applications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Gate Driver Cores</td>
<td>• Patented Augmented Switching™ Technology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Plug &amp; Play Gate Drivers</td>
<td>• Field Proven Gate Drivers for SiC &amp; IGBT</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• Standard off the shelf &amp; Custom Solutions</td>
</tr>
<tr>
<td>Power Discretes</td>
<td></td>
<td>• SiC die</td>
<td>• One of the broadest portfolios on the market</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Discrete SiC MOSFETs</td>
<td>• QSS (Quality, Supply, Support)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Discrete SBDs (Schottky Barrier Diodes)</td>
<td>• 30+ years in dev, design and support of power discretes</td>
</tr>
<tr>
<td>Power Modules</td>
<td></td>
<td>• SiC MOSFET power modules</td>
<td>• Standard packages and architectures available</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• SiC Diode power modules</td>
<td>• Standard and Custom power modules</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Flight proven heritage on both Boeing and Airbus Platforms = proved reliability in critical applications</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• High design flexibility</td>
</tr>
<tr>
<td>Integrated Power</td>
<td></td>
<td>• Power Control Module (PCM), Hybrid Power</td>
<td>• Highest level of integration and reliability for flight critical applications</td>
</tr>
<tr>
<td>Solutions</td>
<td></td>
<td>Drive Modules (HPD/HPE)</td>
<td>• Standard SiC solution available as well semi-custom SiC and IGBT offerings available</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Partial discharge, current monitoring, over voltage, solenoid drive, short circuit protection, digital interface for control, screw and solder options</td>
</tr>
</tbody>
</table>
AgileSwitch Digital Programmable Gate Drivers are solving challenging SiC implementation issues

- Noise
- Short Circuits
- Overheating
- Overvoltage
Why force fit an old analog approach when there is a clearly superior digital solution?
Analog Solutions were alright for Silicon switches
But for SiC...

Analog is irresponsible and unnecessarily dangerous
AgileSwitch® Drivers
tame the SiC beast…

… And unlock the full capability of SiC
For SiC - Digital Programmable is a superior solution versus Analog

**Standard Analog Drivers** vs. **AgileSwitch® Gate Drivers featuring Augmented Switching™**

- Reduces Undershoot
- Reduces Overshoot
- No False Faults
- Mitigates Ringing
- Lowers EMI
- Reduces Overshoot
- Reduces Undershoot

- Up to 80% lower Vds overshoot
- Up to 50% lower switching losses
- Robust and fast Short Circuit protection
ICT Cuts development time

Competitors
Manually change every time

AgileSwitch® Intelligent Configuration Tool (ICT)
Optimize with a keystroke
AgileSwitch® Drivers
revolutionize Analog controls
with Digital Programmable Augmented Switching

- Robust fault prevention
- Higher efficiency
- Accelerated development
- Future proof
<table>
<thead>
<tr>
<th>Customer Design Challenge</th>
<th>Reason for Challenge</th>
<th>How Augmented Switching Helped</th>
</tr>
</thead>
<tbody>
<tr>
<td>False Alarms: Short Circuit, Under Voltage</td>
<td>Noise in the system; Noise in the system;</td>
<td>Robust detection &amp; protection circuitry</td>
</tr>
<tr>
<td>Short Circuit response too slow</td>
<td>Old, plodding, Analog technology</td>
<td>Fast, accurate digital solution</td>
</tr>
<tr>
<td>Unmanageable Voltage Overshoot</td>
<td>Inefficient internal connection system</td>
<td>Precise software configurable “tuning”</td>
</tr>
<tr>
<td>Insufficient module performance data</td>
<td>Limited existing driver fault feedback</td>
<td>Provided 7 specific fault codes, including temperature and voltage monitoring</td>
</tr>
</tbody>
</table>
Seamless transition from development to production

**Evaluation/Development**
- Development support
- Flexible platform
- Optimize module performance

**Production**
- Factory programmed
- Factory Conformal Coating
- 100% Tested

Intelligent Configuration Tool (ICT)  
Module Adapter Boards (MAB)  
ICs  
Cores  
Plug & Play
Plug & Play Gate Driver Boards for standard module packages

Key Gate Driver Features:

- Patented Augmented Switching
- Patented Robust Short Circuit Detection
- Temperature & DC Link Monitoring
- 7 Unique Fault conditions
- UVLO, OVLO
- Overcurrent Protection
- Master-Slave Compatible
Gate Driver Cores for a wide range of modules

2ASC Series (1200V)
3W/ 10A

2ASC Series (1700V)
5W/ 20A

Key Gate Driver Features:

- Fully Software Configurable
- Patented Augmented Switching
- Patented Robust Short Circuit Detection
- Reference Design Portfolio

- 7 Unique Fault conditions
- UVLO, OVLO
- Overcurrent Protection
- Temperature & DC Link Monitor

<table>
<thead>
<tr>
<th>Programmable Vgs</th>
<th>Low Limit</th>
<th>High Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate Positive (V)</td>
<td>12</td>
<td>21</td>
</tr>
<tr>
<td>Gate Negative (V)</td>
<td>-5</td>
<td>0</td>
</tr>
</tbody>
</table>
Core Module Adapter Boards for rapid evaluation

- Dedicated design & support team
- Readily available family of tested Module Adapter Boards
- Custom Adapter Boards (NRE)
- Cores production qualified

SP6CA1 Core Module Adapter

2ASC-12A1HP Core

SP6LI Module
### Module Adapter Boards – evaluation qualified

<table>
<thead>
<tr>
<th>Adaptor Board P/N</th>
<th>For Module Type</th>
<th>Module Image</th>
<th>Availability</th>
<th>Data Sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>62CA1</td>
<td>62mm (D3)</td>
<td><img src="image" alt="62mm (D3) Module Image" /></td>
<td>Released</td>
<td>Available</td>
</tr>
<tr>
<td>EDCA1</td>
<td>Rohm E/G Type</td>
<td><img src="image" alt="Rohm E/G Type Module Image" /></td>
<td>Jan 2020</td>
<td>Available</td>
</tr>
<tr>
<td>XMCA1</td>
<td>Wolfspeed XM3</td>
<td><img src="image" alt="Wolfspeed XM3 Module Image" /></td>
<td>Feb 2020</td>
<td>Dec 2020</td>
</tr>
<tr>
<td>SP6LICA1</td>
<td>SP6LI</td>
<td><img src="image" alt="SP6LI Module Image" /></td>
<td>Feb 2020</td>
<td>Dec 2020</td>
</tr>
</tbody>
</table>
Application Development Kits accelerate development time and reduce TTM

2ASC-12A1HP - 62CA1

Contents:
- 3x 2ASC-12A1HP 1200V Cores
- 1x 62CA1 1200V 62mm Module Adapter
- 1x Device Programmer Kit
- 1x AgileSwitch Intelligent Configuration Tool Software

Module Compatibility:
- Standard 1200V 62mm Style Modules
Development tool to adjust gate driver settings:

- Augmented Switching™ profiles
- Fault Reporting
- On & Off Gate Voltages
- DC Link & Temperature Trip Levels

System Optimization with a Keystroke

![Graph showing Vmax and Eoff vs 2 level turn-off voltage]
Test results: Reduced Voltage overshoot

**Test Setup**

- **Analog Driver**
  - DUT: CAS300M17BM2
  - Vdc = 1000V
  - Isc = 5kA
  - Driver: Prodrive 1700V
  - Vovershoot = 500V

- **AgileSwitch 62EM1**
  - DUT: CAS300M17BM2
  - Vdc = 1000V
  - Isc = 4.5kA
  - Driver: AgileSwitch 62EM1
  - Vovershoot = 200V
What's Next?

ASD2
Non-Isolated
ES Q2 2020

XIFM Series (3300V)
7W/ 30A
ES Q3 2020

ASD3
Isolated
AECQ-100
ES Q4 2020

Key Gate Driver Features:

- Patented Augmented Switching
- Patented Robust Short Circuit Detection
- Temperature & DC Link Monitoring

- Intelligent Paralleling™
- Overcurrent Protection
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