Software Configurable Cores – Building Blocks for Driving SiC MOSFETs

- Rob Weber
Fiber Optic was initially installed the same way as copper wire (running 100 meters at a time). Fiber could be run up to 2 km at a time. This old method of installation was
• Slow
• Expensive
Early Electronic Keyboards relied on analog synthesizers to emulate a piano.

We implemented digital control to provide precise and accurate audio waveforms.

We are now applying this to Power.
Why Force Fit an Old Analog Approach when there is a Clearly Superior Digital Solution?
Digital Programmable is a Superior Solution over Analog

Better Control of:

- False Faults
- Ringing
- Electromagnetic interference
- Overshoot
- Undershoot

**AgileSwitch** is “first to market” with a Digital Programmable Gate Driver for SiC

Augmented Switching™ is protected by key technology patents
Analog Solutions were alright for Silicon switches
But for SiC, Analog is Irresponsible And Unnecessarily Dangerous
AgileSwitch Tames the SiC Beast

Unlock the Full Capability of SiC
Digital Programmable Gate Driver Benefits

Up to 50% Lower Switching Losses

Up to 80% Lower Turn-Off Vds Overshoot
Mitigate Noise Issues

- False Alarm
- Unexpected Stop
- Catastrophic Failure
Better Protection

- Short Circuits
- Overheating
- Overvoltage
Everyone Else

- Slows Device
- Wastes Energy
Field
Upgradable
Internet of Things Ready
AgileSwitch - Optimize with a Keystroke
Digital Programmable

Analog
Competitors
AgileSwitch Intelligent Configuration Tool - Example

Change DSAT Settings

- Example Ids Vds Vgs
- Example Ids Vds Vgs

[Images of the AgileSwitch Intelligent Configuration Tool and graphs showing data points]

- P2: rms(C1) 852.2 mV
- P3: rms(C2) 524.1 V
- P4: max(C1) 1.826 V

- P2: rms(C1) 812.2 mV
- P3: rms(C2) 525.9 V
- P4: max(C1) 1.843 V
With Reduced Losses and Improved Control

- Drive Farther
- Charge Faster
Who we are

- Dedicated Gate Driver Design and Manufacturing
- Founded January 2010 by serial entrepreneurs Albert Charpentier and Rob Weber
- Headquartered in Philadelphia, PA (US East Coast) with Regional Offices in Asia and Europe
- Local sales, marketing and support globally

**Headquarters**

2002 Ludlow Street, Philadelphia, PA USA

**Global Offices**

London, United Kingdom

Bangalore, India
Customers
### Why Customers Choose AgileSwitch

<table>
<thead>
<tr>
<th>Customer Design Challenge</th>
<th>Reason for Customer Challenge</th>
<th>How Augmented Switching Helped</th>
</tr>
</thead>
<tbody>
<tr>
<td>False Alarm – Short Circuit, Under Voltage</td>
<td>Noise in the system, not optimized for SiC</td>
<td>Robust 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 code, including temperature and voltage monitoring</td>
</tr>
</tbody>
</table>

“GM is particularly interested in the AgileSwitch approach because the automotive implementation demands robust, and high current density utilization of the SiC MOSFET to be reliable and cost effective.”

Brian Peaslee  
Senior Manager - Electrification Electronics  
General Motors - Global Propulsion Systems
Competitive Landscape

- Analog Hardware
- Analog Software
- Digital Hardware
- Digital Software

- InPOWER
  the systems people

- Firstack

- Semikron
  innovation + service

- Tamura

- Amantys

- AgileSwitch
Digital Programmable Gate Driver Boards

Key Gate Driver Features:

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

EDEM Series (1200V)
3W/
15A

62EM Series (1700V)
10W/ 20A

XIFM Series (3300V)
7W/
30A

- 7 Unique Fault conditions
- UVLO, OVLO
- Overcurrent Protection
- Master-Slave Compatible
Digital Programmable Gate Driver Cores

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

<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>

7 Unique Fault conditions
• UVLO, OVLO
• Overcurrent Protection
• Temperature & DC Link Monitor
Module Adapter Boards

• Dedicated Design & Support Team
• Readily Available Family of Tested Module Adapter Boards
• Custom Adapter Boards (NRE)
Digital Programmable Gate Driver ICs

ASD1
Non-Isolated

ASD2
Non-Isolated

ASD3
Isolated
AECQ-100

Key Gate Driver Features:

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

• 7 Unique Fault conditions
• UVLO, OVLO
• Overcurrent Protection
Product roadmap

- **IC v1.0**
  - Industry first SiC-ready IC (2016)
- **Board v2.0**
- **Core v2.0**
- **Next Gen Board & Cores (2019+)**
- **Next Gen IC (2019)**
- **Boards and Cores (2017)**
AgileSwitch is Revolutionizing Analog Controls with Digital Programmable Augmented Switching Technology

- Robust Fault Prevention
- Higher Efficiency
- Accelerated Development
- Future Proof
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