PowerSoC & PowerSiP markets are preparing. Are you?

Or Micro-power electronics world explained

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Outline of the presentation

- Introduction
- PowerSiP & PowerSoC World
- Enabling Power SiP
- Trends to watch
- Conclusion
Introduction
Power electronics and power consumption are under the spotlight:

- At high power for renewables, transport...
- At low power for tablets, phones, laptops and all embedded electronics

Drivers towards micro power electronics integration are here, and the market will follow:

- Power efficiency
- Power output stability
- Time-to-market
Computing power vs. Consumed power (1/2)

Source: Intel, Wikipedia, “Dr. Dobb's Journal” #3 03/2005

Intel processors specifications evolution since… 1975

- Transistors (thousands)
- Frequency (MHz)
- Typical power (Watts)

Frequency and energy consumption diet

Year

1980 1990 2000 2010

1000000
100000
10000
1000
100
10
1
Power system size reduction: Trendy at all levels!

**Power supplies**

<table>
<thead>
<tr>
<th></th>
<th>Traditional</th>
<th>Prototype</th>
<th>Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lifetime</strong></td>
<td>2 years</td>
<td>6 years</td>
<td>10 years</td>
</tr>
<tr>
<td><strong>Efficiency</strong></td>
<td>85%</td>
<td>86%</td>
<td>92%</td>
</tr>
<tr>
<td><strong>Frequency of switching</strong></td>
<td>150 kHz</td>
<td>30 MHz</td>
<td>+100 MHz</td>
</tr>
</tbody>
</table>

**Cost**

- 2013:
  - 100%
  - 100%
  - 100%

- 2015:
  - 50%
  - 20%
  - 20%

- 2020:
  - 30%
  - 10%
  - 10%

**Size**

- 2013:
  - 100%
  - 100%
  - 100%

- 2015:
  - 50%
  - 20%
  - 20%

- 2020:
  - 30%
  - 10%
  - 10%

**Weight**

- 2013:
  - 100%
  - 100%
  - 100%

- 2015:
  - 50%
  - 20%
  - 20%

- 2020:
  - 30%
  - 10%
  - 10%

Source: DTU - Arnold Knott – ECPE Workshop 2015

Hypothesis on a 50W-100W range power supplies
PowerSiP & PowerSoC world
PowerSiP & PowerSoC: Definitions 1/2

- **PowerSiP**
  - MCM Power IC
  - Co-package Driver+FET

- **PowerSoC**
  - Driver+FET
  - Monolithic Power IC
  - FET driver
  - Power FET

- **Passives**
  - Inductor
  - Capacitor

- **Components**
  - LDO
  - Control IC
  - PMU

**Package integration**

**Wafer integration**
The key hurdle is still passives: Integration in package or on wafer.
Most advanced solution to date: PowerSiP

Wafer integration

Haswell Platform

intel

FIVR VRs:
Vccsa
Vccio
Vccioa
VccCore 0
VccCore 1
VccCore 2
VccCore 3
VccCache
Graphics0
Graphics1
VccEDRAM
VccOPIO

Logic Blocks

DDR VR
DDRx

VccIn
0V-1.8V

Package integration

Intel

Empirion
Power Solutions

Inductor
Controller
2 MOSFETs
High-frequency filter capacitors

Panasonic

Ferrite substrate with embedded inductor

muRata
INNOVATOR IN ELECTRONICS
Enabling PowerSiP

with advanced packaging
Competing Wafer/panel scale packaging landscape

Candidates for Power Electronics Integration

- **Embedded IC**
  - Larger pitch: 50-100µm
  - For med-density
  - Low I/O number
  - Easier passive integration

- **3DIC**
  - Ultra fine pitch: <20µm
  - For hi-density
  - Hi I/O number

- **Interposer**
  - Ultra fine pitch: <20µm
  - For hi-density
  - Hi I/O number

- **P-o-P**
  - Large pitch: 250µm
  - For med-density
  - Low I/O number

Packaging leaders:

- AT&S
- TDK
- DEVICES
- Amkor Technology
- STATSChipPAC
- ASE GROUP
Example: AT&S ECP

- Single Power Device embedded
- Up to 10A
- Substrate level integration:
  - 40% to 70% footprint reduction

- **Applications**
  - Power Management Unit
  - Li Battery charger
  - µDC/DC buck converter

Applied in:
- GaNsystems 600V devices
Example: TDK SeSUB

- All integrated System-in-Package solution
- Up to 8A
- 40% to 70% footprint reduction
- Low power only (less than 5V)

- Applications
  - Power Management Unit
  - Li Battery charger
  - μDC/DC buck converter

Applied in:
- Blackberry Z10 smartphones (2013)
Example: ASE a-EASI

- Half-Bridge + Driver Power Device
- Up to 10A
- Substrate level integration:
  - 40% to 70% footprint reduction

- **Applications**
  - Power Management Unit
  - Small Power Converter/inverter
  - DC/DC converters

Applied in:
- Infineon Half-Bridge
Micro Power Electronics device manufacturers

- Mainly US based companies
Integrated power maker’s product positionning

High end

PowerSoC

PowerSiP

DC/DC converter modules

Panasonic

Low end

Product range

Small volume

Mass production

Volume of production

PowerSiP

PowerSoC
Asian companies will be the « doers » (Fab and packaging).
M&A in the « Micro power electronics » world

$16.7B acquisition in 2015

$134M acquisition in 2013

$6.5B acquisition in 2011

$839M acquisition in 2015

$605M acquisition in 2013
M&A in the « Micro power electronics » world

Intel, Altera, Microchip

- FPGA
- ASIC
- µprocessor

Enpirion, Volterra, Micrel...

- DC/DC converter
- Power IC
- Patent and IP

- Semiconductor heavy players, having needs for power management in their integrated computing ICs.
- Spending what's needed to have both Information processing and power processing
Applications of PowerSoC and PowerSiP

Used for “fast design cycle” and “PCB space saving”

Total Accessible market 2016

- Personal electronics
- LED lighting
- Server & Data computing
- Home appliances
- Wearable Electronics
- Autonomous car
- Military Satellite Communications

1st target market
PSiP and PowerSoC market forecast

PwrSoC and PSiP market forecast in USD Millions

This is a preliminary figure. It is subject to evolution and adjustment. Your feedbacks are welcome!

*Figures include only open-market
Trends to watch
The key role of Packaging in today’s supply-chain

- Advanced packaging players will be at the heart of Power Electronics SiP/SoC supply-chain (as they are today for other SiP-SoC)
GaN IC → higher power integration levels

Power+IC on the same GaN Wafer

Potential design of a GaN Power IC

Illustration example based on Powdec SJ GaN design

Companies to watch in GaN based power ICs

Texas Instruments
Cambridge Electronics
Navitas
Dialog Semiconductor

Target applications

LED lighting
Home appliances
AC adaptor
Conclusion
Conclusion

• Strong market drivers
• Need for better performance and specifications
• Technologies becoming available
• Strategic acquisition of companies and their know-how/knowledge

PowerSoC and PowerSiP is very active.
We are at the edge of an evolution, to become a revolution.

At very low power:
Intel is making most of it, with its integrated VR in Haswell processor combined with Enpirion’s acquisition (through Altera). Other players also work toward this path integrating passives and low power devices.

At Low Power:
All Power management unit maker’s are willing take profit of the technologies and supply-chain in place for other applications (MEMS, RF...). Power Electronics will become another application of several SiP packaging technologies.

At Medium Power:
Start-ups will come with concepts, IP and patents of integrated converters unleashing performances from GaN and VHF conversion. GaN IC with integrated drivers will help! Passive components maker have now a reason to develop integrated passives. But this will come step by step: System makers need to be assured it will work!
Feel free to ask any question...
This is an on-going work, Feedbacks are welcome

Check [www.PointThePower.com](http://www.PointThePower.com) for updates on PowerSoC and PowerSiP, and power electronics in the future

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Point the Gap

Your tailor made market intelligence specialist

Experts in power electronics and semiconductor markets

alex@pointthegap.com
The idea: A tailor made market intelligence service

Keep track of your competitors and competing technology...

...and anticipate and act knowing the landscape

Validate your products and projects in the competitive landscape...

...and identify your new market opportunities

Gather your team to discuss competitive landscape...

...and put them on a learning curve about market and technologies
What we do? **Market intelligence**

**Market research:**

« How can I know my strategy is right? »

- **Direct interviews** with experts
- **Analysis of business models** and strategies
- **Custom report** tailored to your needs

Get the full picture of your market

**Anticipate** trends and evolutions
What we do? **Market Intelligence**

**Marketing survey:**
« What are the markets for my technology? »

Direct interviews with experts

Innovation marketing methodologies

Evaluate your innovations or technologies

Build your strategy on facts and feedbacks from the field
What we do? **Market reports**

« *The best market reports are the one, answering your key questions* »

*With thousands of potential leads to investigate, let’s decide together which subjects are crucial!*

1. **You pre-buy a report**
   We suggest a list of reports.
   You pre-buy the reports you need.
   As a pre-sales, the report is not available now, but is also cheaper.

2. **We get to work**
   For 4 to 6 weeks, we follow our proven design process: phone interviews, data scouting and nights of analysis!

3. **You receive a market report answering your questions**
   You are charged when the report is delivered, and can enjoy specific information at competitive price.
Conversion is needed everywhere, as we produce electricity in one place, transport it and use it for different purposes in different places. Improving power converter's efficiency is key in our way to a sustainable future.

Material and packaging level

These switches are made from a raw semiconductor material sliced into wafers that is subject to chemical treatments, processes, then diced into dies. Each small piece of wafer (a die) can then be packaged to be used as a switch.

- Inversion is made using switches to make a direct current flow alternatively in one way and the other. The controlled switch is the basic of semiconductor and power semiconductors. Controlling the switches, we can control the voltage and the frequency of the output. It is then smoothed using filters, to approach a sinus wave.
Market reports: GaN devices and applications

Gallium Nitride devices and applications
All about device makers and targeted applications – August 2016

Gallium Nitride power devices market difficult to estimate

GaN power devices market to 2020 draft estimation

GaN power devices players: What and how?

GaN power devices start-ups & heavy players

Heavy players

Start-ups

GaN power devices market to 2020 draft estimation

GaN power devices players: What and how?

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Start-ups
How we do it: Our expertise in action

How we do it:

Step 1
Get to know you, your projects, your targets

Step 2
Direct interviews
Conferences
Web & Data Mining
News

Step 3
All tailored to your specific focus and needs using:
- Data mining software
- Data graph tools
- Design results
- Business model analysis
- Innovation Marketing
- Market analysis tools

Results
Market intelligence
Market research
Marketing survey
Our expertise: concerned fields

Power electronics:

*From material,*

*through manufacturing,*

*passives and assembly,*

*and up to applications*
Who we are

*Point the Gap* is...

...made of “communicating-business-technologists”:

- Readable material
- Business-oriented
- Technology expertise

...initiated by Alex AVRON

*Eng. Electronics and semiconductor*

4 years experience as *Market and Technology analyst in Power semiconductors at Yole*

*Competitive intelligence teacher in University*