Application Benefits Achieved Utilizing IGBT5-Based Power Semiconductors

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The Designer’s Challenge

- Space Restrictions

- Functional Safety

- Thermal Aspects
Driving Demand – Increased Power Density

Volume reduction >70%,
Weight reduction >80%
Moore’s Power Electronic Law: Power Density doubles every 5 years
Optimization on Chip Level

- Eliminate soft soldered joints
- Copper surfaces
- Copper bond wires
- Increase in power cycling lifetime by factor 10

N. Heuck et.al.
*Aging of new Interconnect-Technologies of Power-Modules during Power-Cycling*
Published at CIPS, 2014
IGBT5 and .XT Technology
25% Increased Power or 10 Times Longer Lifetime

- Increasing power density by 25%
- Extend lifetime by a factor 10
- Less cooling effort for the same output power
- Enabling higher system overload conditions
High-Reliability solder joint

- EconoDUAL™ 3
- Industrial Module
- Qualified to achieve 12k Cycles in thermal cycling tests

40k Cycles

$\Delta R_{\text{thjc}} < 20\%$
PrimePACK™ 3+
Higher output power from the same footprint

- Additional AC terminal and bus bar
- Increased output current
- Additional Control Terminal
- Low-inductive connection to the collector of the low-side IGBT

New PrimePACK™ 3+
Integration into the Application

- ModSTACK-HD
- 3x FF1400R17IP4
- 3x FF1800R17IP4

Plug & Play replacement only!
To be observed...

- Just using Plug & Play demands for closer monitoring of critical temperatures within the setup

- DC-Bus temperature is captured
- AC-Terminal temperature is monitored
- Module’s Case temperature is measured
- Junction temperature is taken
Results achieved

30% Higher power at tolerable temperature increase
The limiting factor is the AC-terminal’s temperature, resulting from the current sensor’s specification $T_{\text{sens\_max}} = 90^\circ\text{C}$.
Scenarios for the Application

Power Electronic Solution based on IGBT4

Power Electronic Solution based on IGBT5 + .XT

Power Electronic Solution 2 based on IGBT5 + .XT

\[ P_{out} \]

\[ 130\% P_{out} \]
Conclusions

- Moore’s *Power Electronics* Law remains

- Higher power densities lead to temperature increase

- New technologies allow handling increased temperatures without sacrificing lifetime

- Dedicated Designs instead of Plug & Play will result in even higher gains
ENERGY EFFICIENCY
MOBILITY
SECURITY

Innovative semiconductor solutions for energy efficiency, mobility and security.