### Tutorial: The Benefits of Integrated PowerSoCs Versus Discrete Power Converters



© 2016 Altera—Public

### Switch Mode DC-DC Step Down Converter: Discrete versus PowerSoC Implementation



### Switch Mode DC-DC Step Down Converter: Discrete Implementation



### Switch Mode DC-DC Step Down Converter: Discrete Implementation



### Switch Mode DC-DC Step Down Converter: Discrete Implementation



### Switch Mode DC-DC Step Down Converter: PowerSoC Implementation



### PowerSoC Products Offer a Much Smaller Total Solution Size Versus Discrete Solutions



4 A PowerSoC



**4 A Discrete Solution** 

The discrete solution takes up 7X more PCB area than the PowerSoC

The PCB area savings that the PowerSoC provides can be used to:

- Reduce the size of the PCB and save cost
- Add additional features or components to the end product that otherwise would not be possible



### **PowerSoC Products Offer Better EMI Performance Versus Discrete Solutions**



4 A PowerSoC

**4 A Discrete Solution** 

- Radiated EMI comes from high di/dt currents flowing in loops
- Radiated power is proportional to the radius of the current loop and decreases by r<sup>8</sup>
  - Since PowerSoC solutions have current loops with a much smaller radius (r) than discrete solutions, the radiated power is significantly lower



# PowerSoC Products Offer Better System Reliability Versus Discrete Solutions

The Failures in Time (FIT) rate of a power converter system is the sum of component FIT fates as follows:

 $FIT_{SYSTEM} = FIT_{CONTROLLER} + FIT_{MOSFETS} + FIT_{INDUCTOR} + FIT_{PASSIVES}$ 

 Competing discrete solutions are not designed, tested, and qualified as a complete power converter system like PowerSoCs are



# PowerSoC Products Offer Better System Reliability Versus Discrete Solutions

The Failures in Time (FIT) rate of a power converter system is the sum of component FIT fates as follows:

FIT<sub>SYSTEM</sub> = FIT<sub>CONTROLLER</sub> + FIT<sub>MOSFETS</sub> + FIT<sub>INDUCTOR</sub> + FIT<sub>PASSIVES</sub>
Competing discrete solutions are not designed, tested, and qualified as a *complete* power converter system like PowerSoCs are

Component	FIT Rate
PowerSoC	2.5
4 MLCC Passives	0.8 (4x0.2)
2 Resistors	0.2 (2x0.1)

4 A PowerSoC

**4 A Discrete Solution** 

FIT Rate
1.5
5
2 (10x0.2)
5
0.9 (9x0.1)

Total FITs: 3.5 Mean Time Between Failure (MTBF): 32,600 years

Mean Time Between Failure (MTBF): 7,900 years

Total FITs: 14.4



### **PowerSoC Devices Help Reduce Development Time and are Lower Risk** Solutions than Discrete Solutions

Typical Discrete DC-DC Converter Design Steps	
Review regulator specifications and requirements	
↓ Select DC-DC regulator device	
→ Solution analysis	
↓ Select inductors	
Select input and output capacitors ↓	
Simulate power stage, input/output filters	
Analyze control design and select compensation network ↓	
Verify time domain analysis/simulation	
Schematic finalized ↓	
Custom PCB layout & bill of material ↓	
Final BOM: component optimization & trade-offs	
System scope creep; requirement change	
PCB design and assembly	
↓ Destature to still a	
Prototype testing	

A typical Discrete DC-DC converter design requires: ~464 people-hours ~19 steps with iterations



### PowerSoC Products Help Reduce Development Time and are Lower Risk Solutions than Discrete Solutions



#### Typical PowerSoC Design Steps

Review PowerSoC specifications and requirements Select PowerSOC device Look up (minimal) external components System scope creep; requirement change PCB design using standard/tested design files Prototype testing

A typical Discrete DC-DC converter design requires: ~464 people-hours

~19 steps with iterations

The PowerSoC Advantage A typical PowerSoC design requires: ~254 people-hours (45% less) ~6.7 steps with iterations



#### **Summary**

# PowerSoC solutions offer many benefits over discrete power solutions such as:

- Reduced PCB cost due to smaller size
- Better EMI performance because of their compact nature
- < Improved system level reliability
- Faster, easier, lower cost, and lower risk development that improves time to market



### **Thank You**

For more information, please visit: www.arrow.com/en/products/manufacturers/a/altera



© 2016 Altera—Public

© 2016 Intel Corporation. Intel, the Intel logo, Altera, Arria, Cyclone, Enpirion, MAX, Megacore, NIOS, Quartus and Stratix words and logos are trademarks of Intel Corporation in the US and/or other countries. Other marks and brands may be claimed as the property of others.