Power Delivery for Modern Data Center

ST Developer Conference
September 2019

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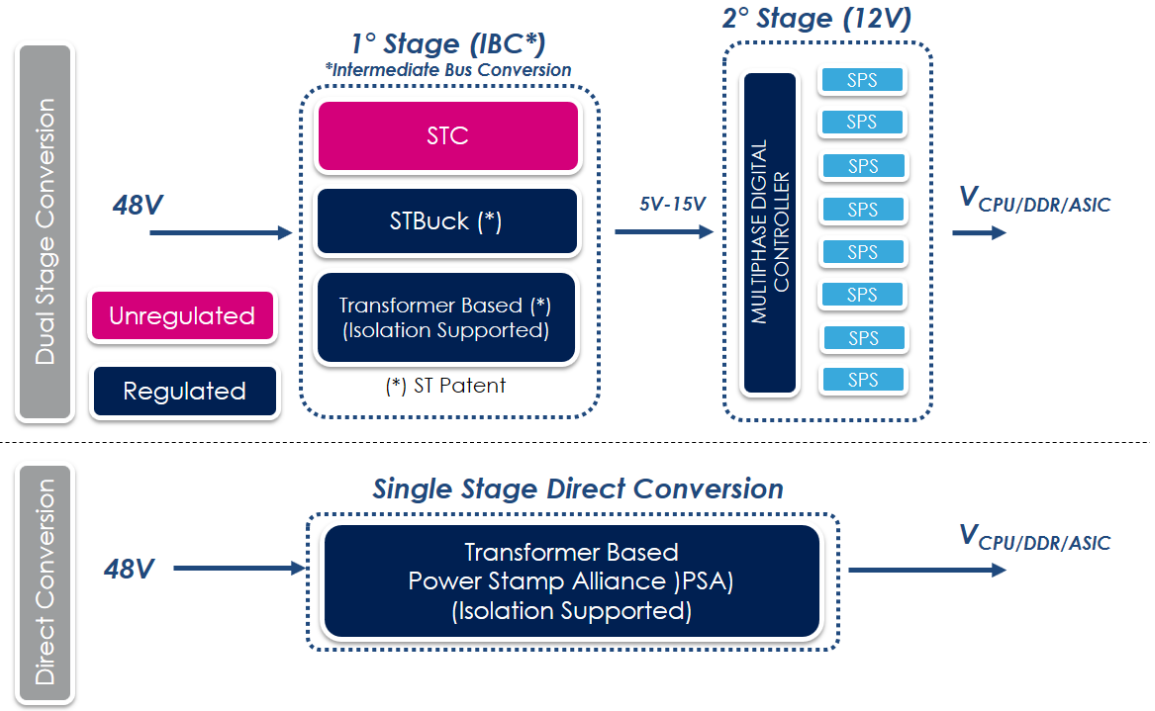
ST Developers Conference | September 12th, 2019
Santa Clara Convention Center - Mission City Ballroom
Santa Clara, CA

Power Delivery for Modern Data Center



Stacked Buck (STB) Regulated Conversion

Switched Tank Converter (STC) Unregulated Conversion

Direct Conversion from 48V to POL

Digital Power Distribution from 12V Bus

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STC (4:1): 48V to 12V

IBC Unregulated Conversion

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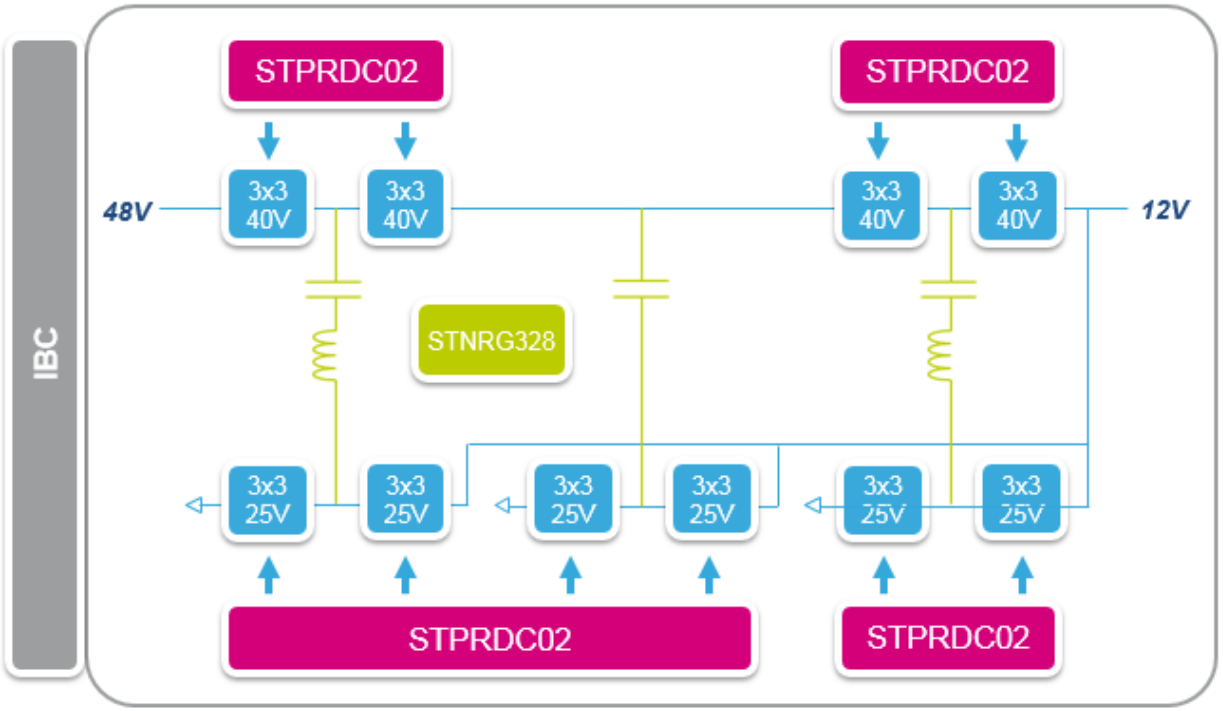
Switched Tank Converter (STC)

Unregulated Conversion

Un-Regulated Intermediate Bus Architecture up to 1KW



- Input Voltage Range: 40V-60V
- 4:1 Conversion Ratio
- Up to 1KW Thermal Design Power (TDP)
- High Power Density
- Maximizes Conversion Efficiency
- Low Profile Solution (<5mm)
- ZCS Operation for all Mosfet
- Off-the-Shelf Components

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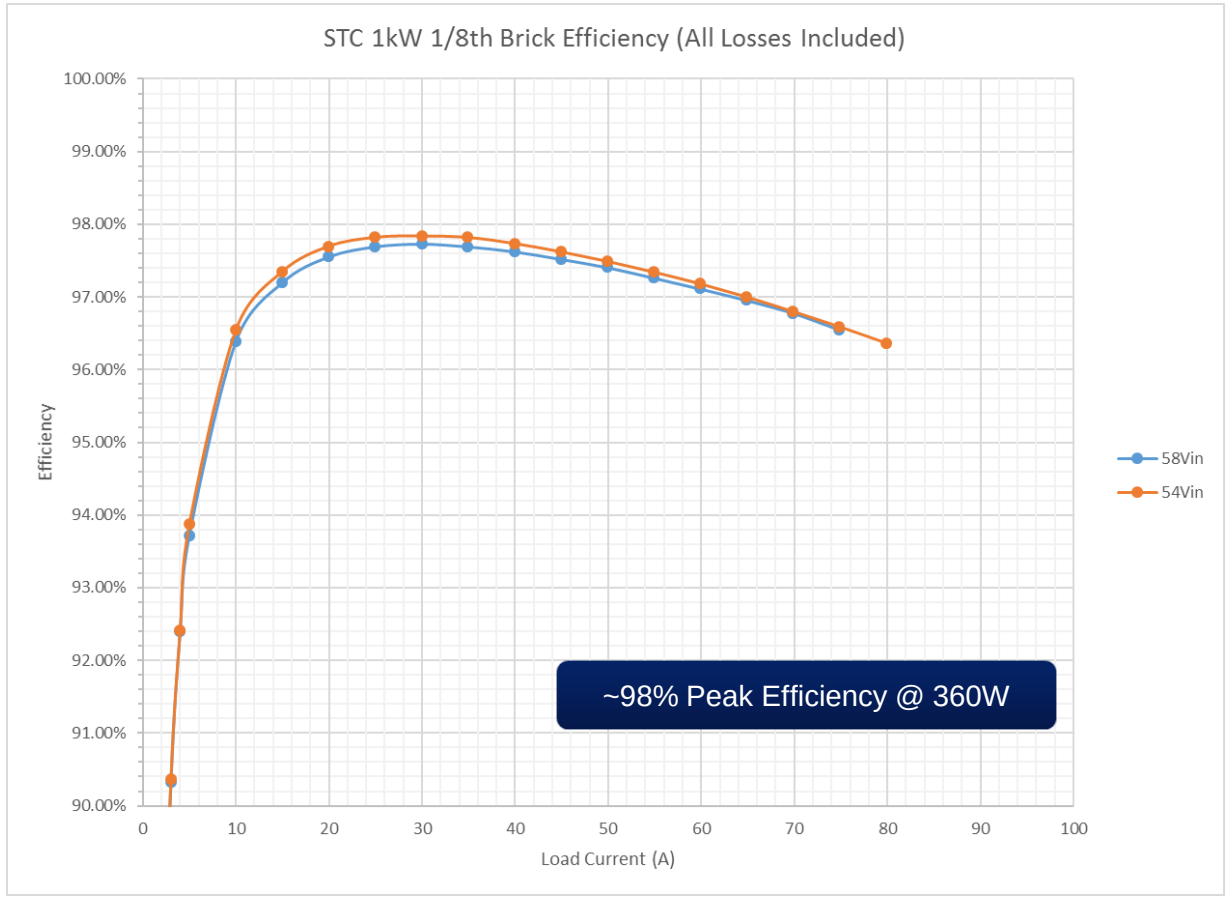
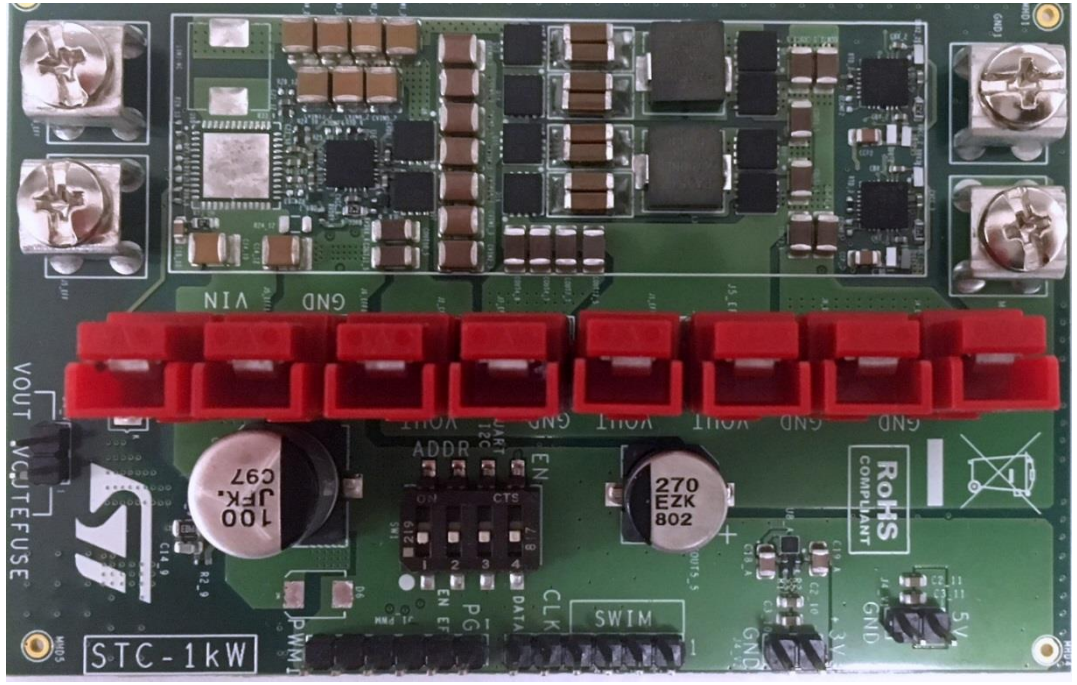
1KW STC Efficiency Results





1/8th Brick Form Factor

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STBuck (STacked Buck): 48V to 12V

IBC Regulated Conversion

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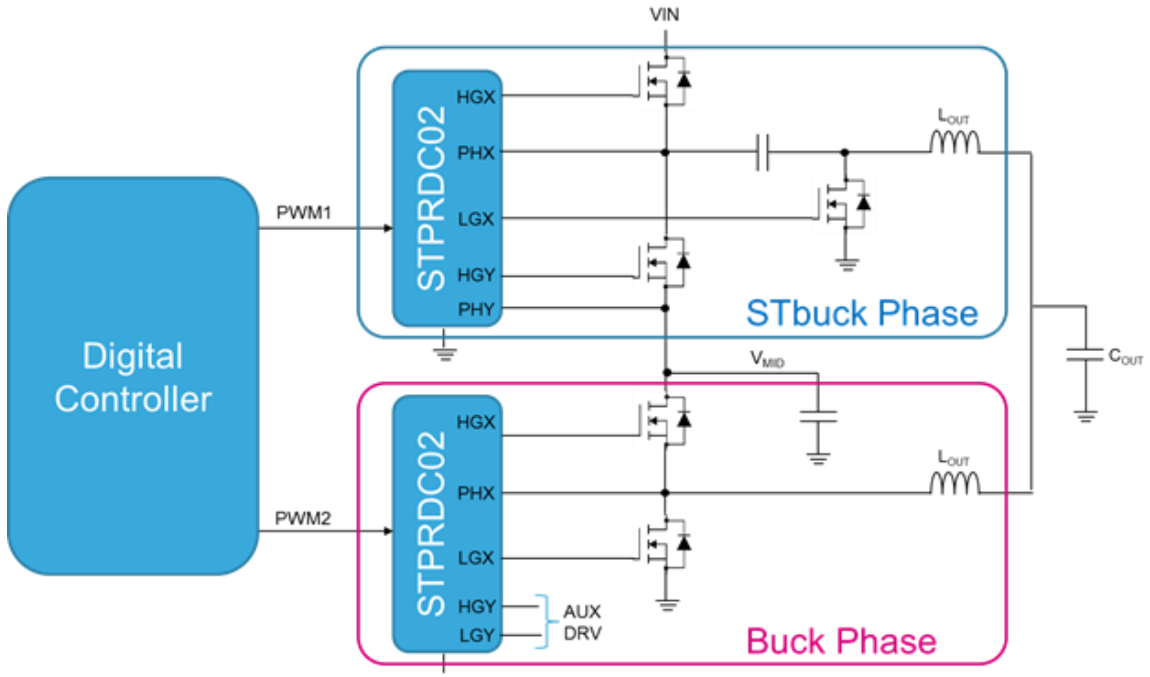
Stacked Buck (STB)

Regulated Conversion

Regulated Intermediate Bus Scalable Architecture up to 3.2KW



- Input Voltage Range: 36V-60V
- 12V Vout Adjustable by PMBus
- 800W Thermal Design Power (TDP)
- High Power Density
- 800W 1/8 Brick From Factor Cell
- Scalable Solution up to Four Cells
- Maximizes Conversion Efficiency
- Off-the-Shelf Components

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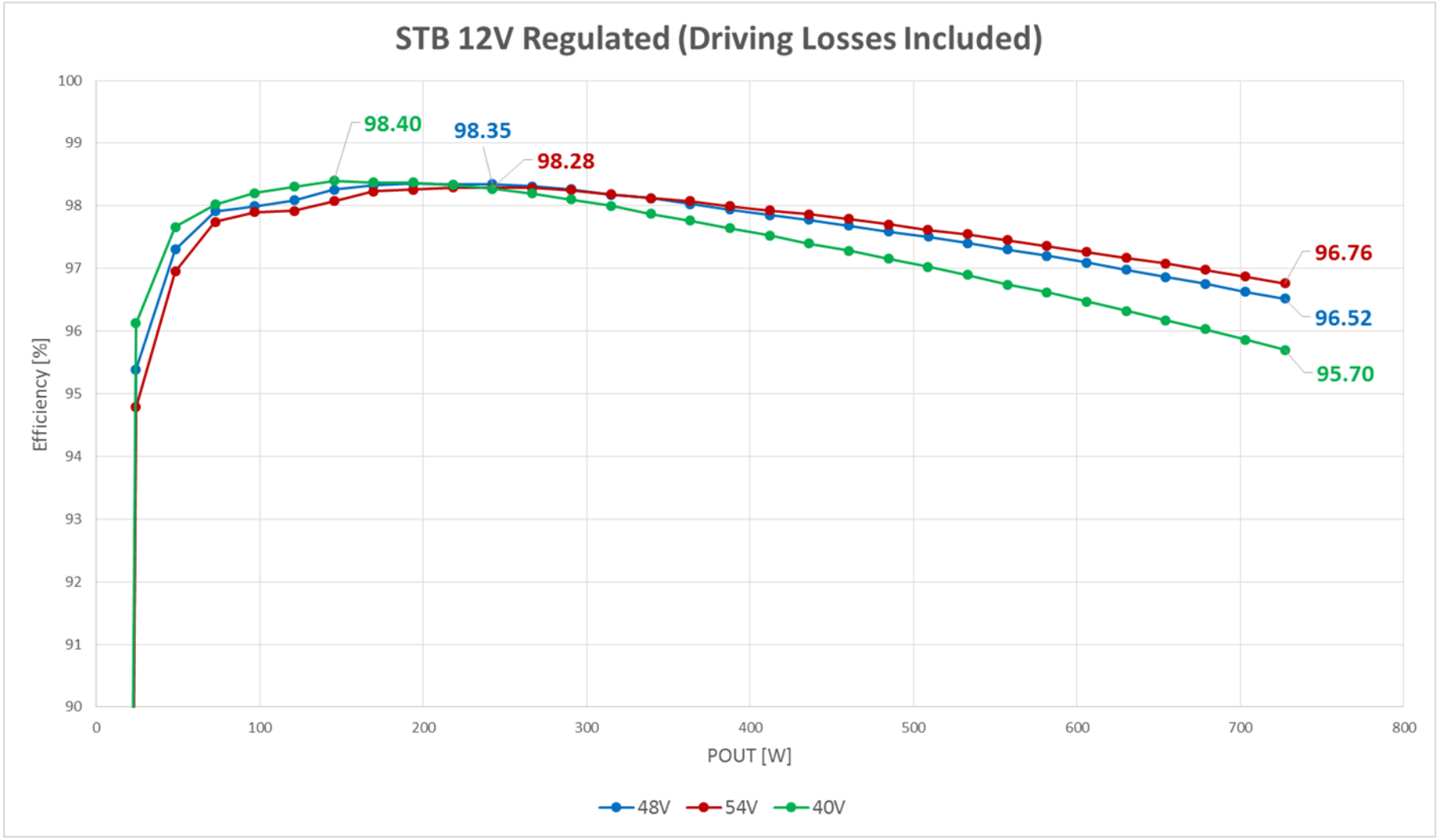
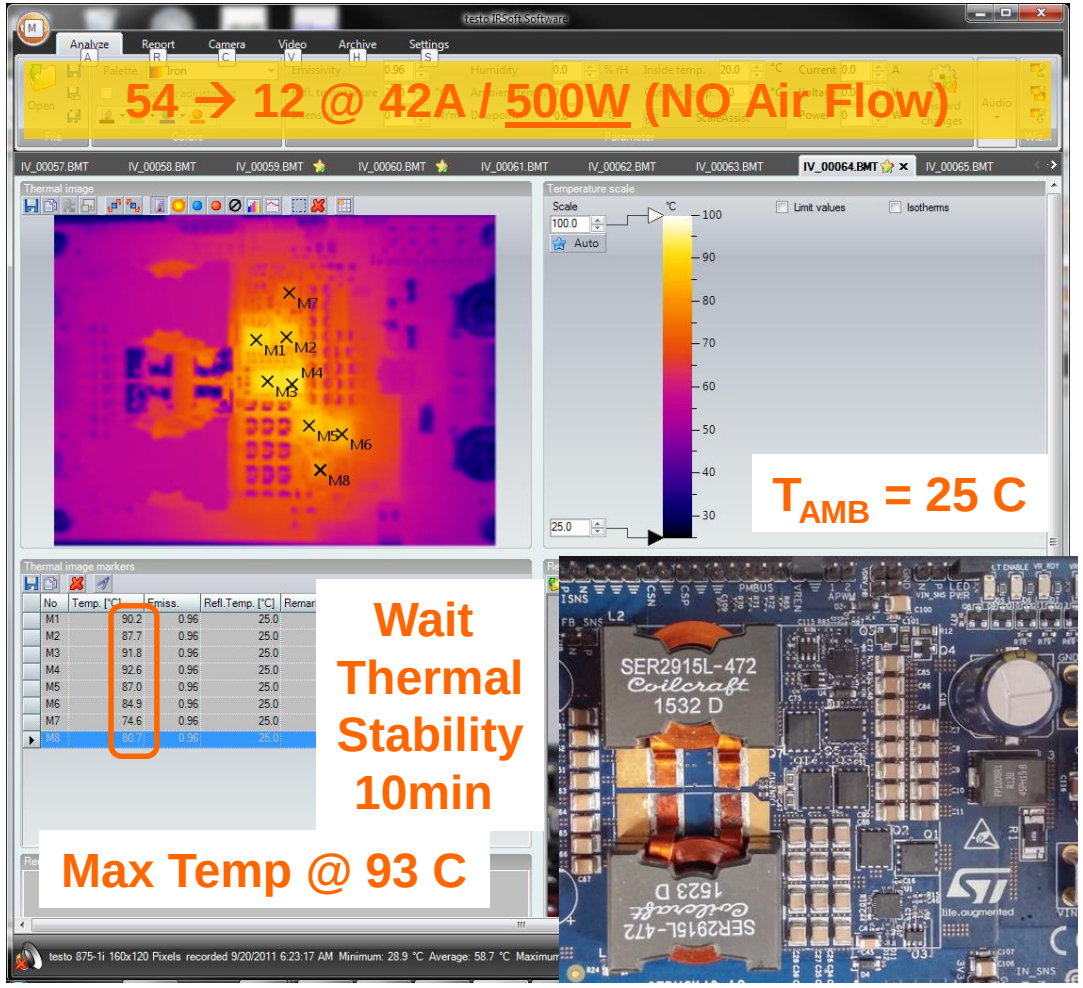
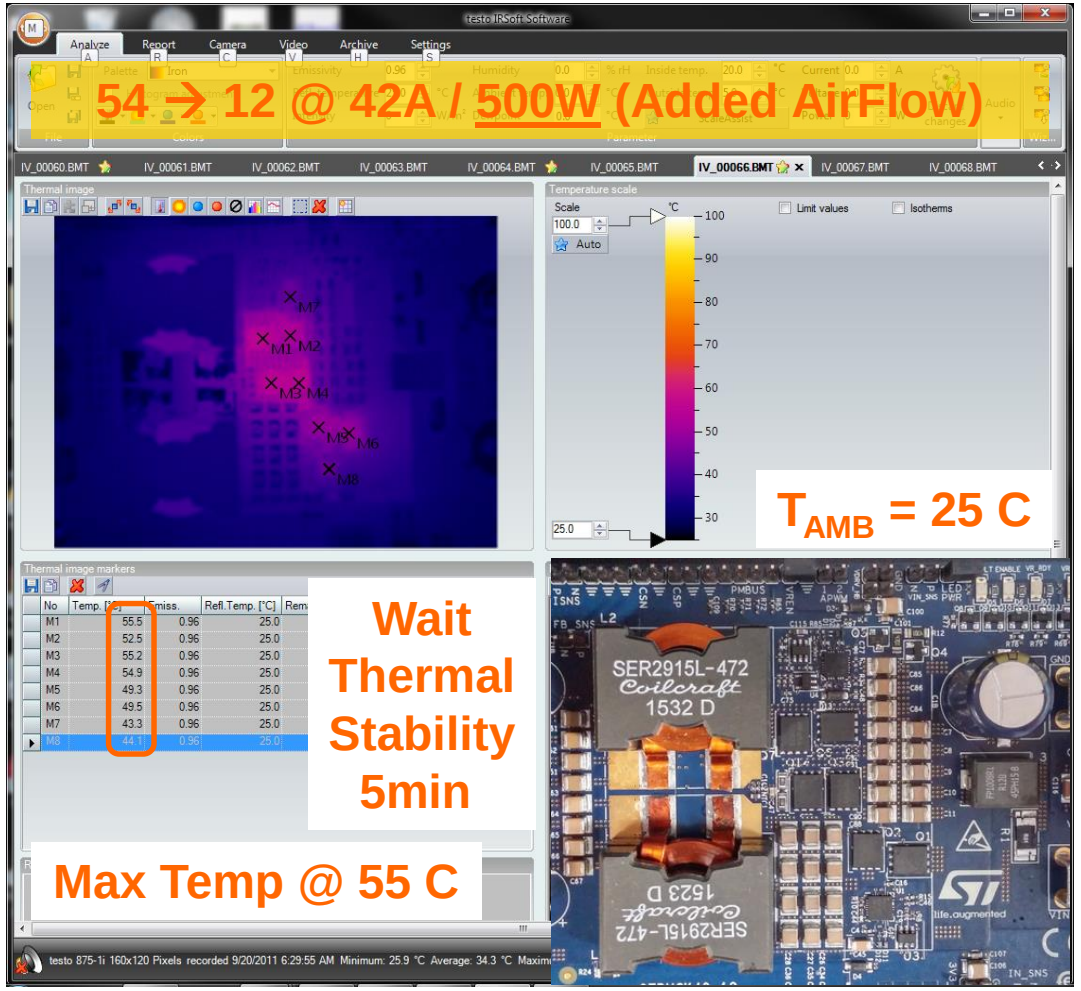
STB Efficiency Results



Thermal Measurements (1)





No AirFlow for 10min @ 500W

AirFlow 70 CFM for 5min @ 500W

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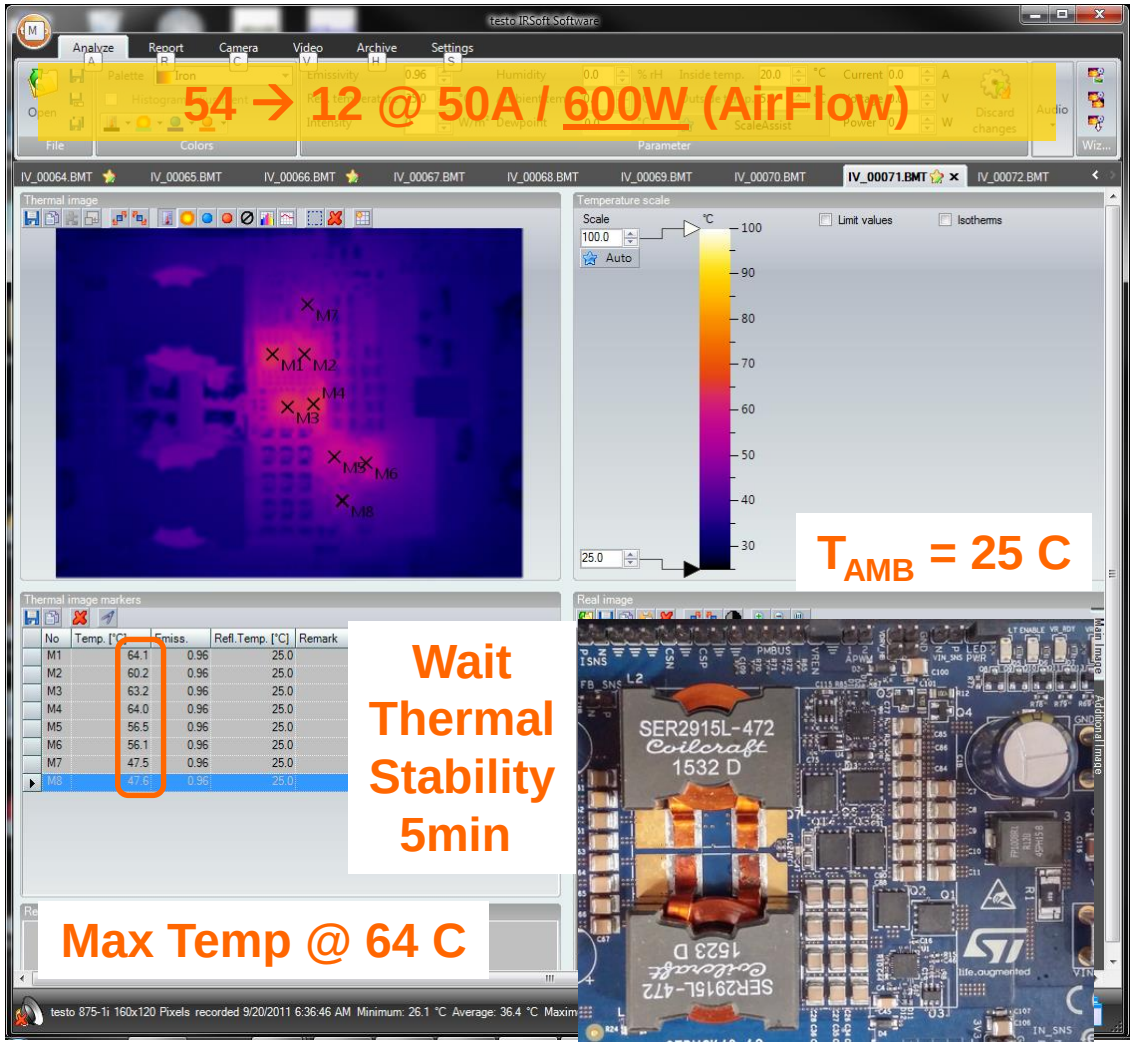
Thermal Measurements (2)



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Direct Conversion 48V to POL

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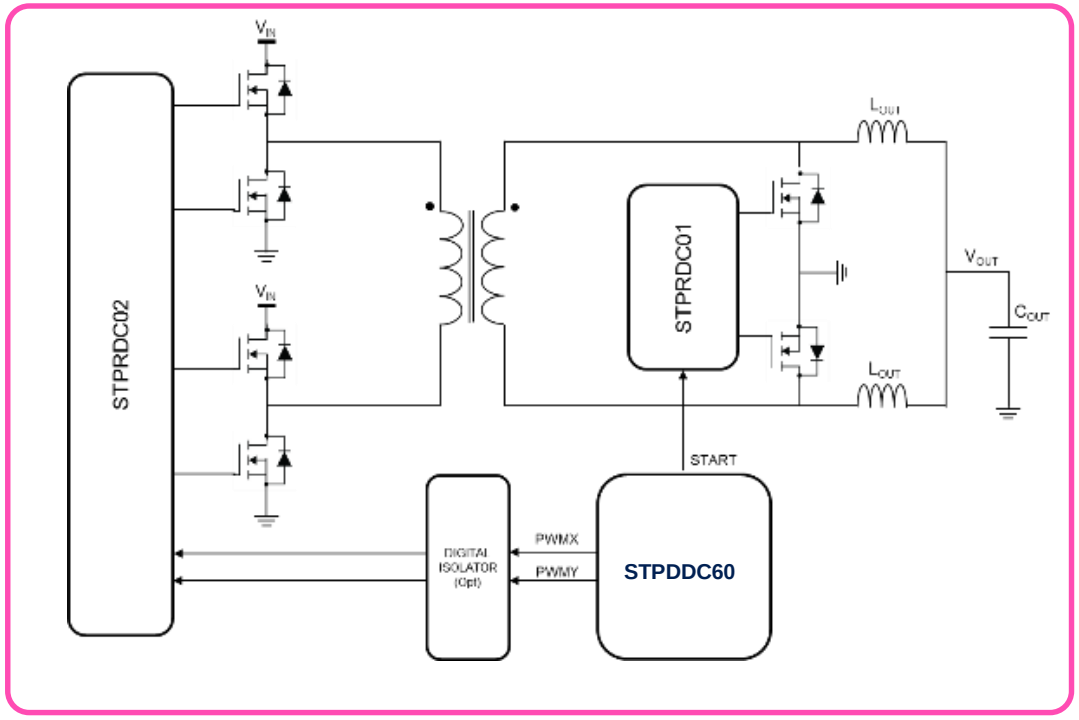
Direct Conversion from 48V to POL

Scalable, Flat Efficiency, High Density, Isolated or Non-Isolated Direct Conversion



- Input Voltage Range: 40V-60V
- Vout: Intel VR13HC ($1.8V_{Typ}$), DDR ($1.2V_{Typ}$)
- Full Compliance to Intel Test Plan
- Vout Load Line: 0.9mOhm
- 205W TDP, 413W Max
- Iout Max: 228A
- Switching Frequency: 570KHz
- Power Density: 100W/$inch^2$
- Solution Size: 1.6’’ x 2.60’’

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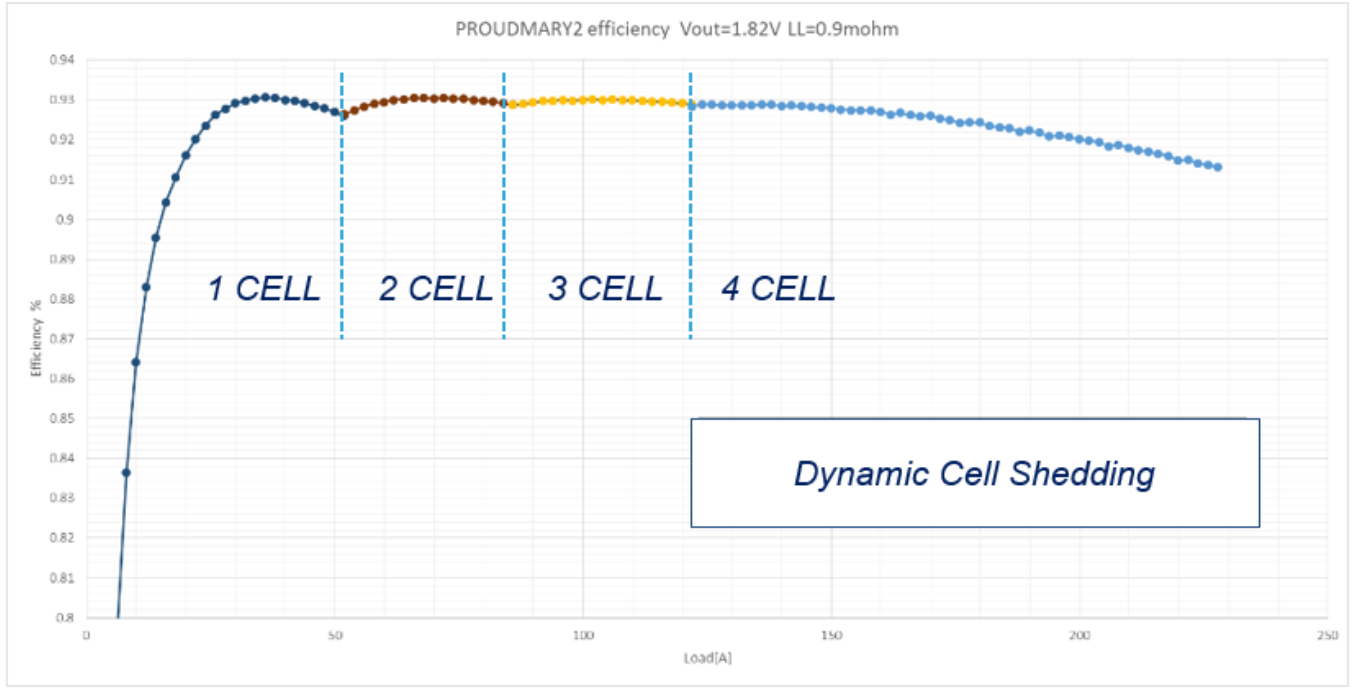
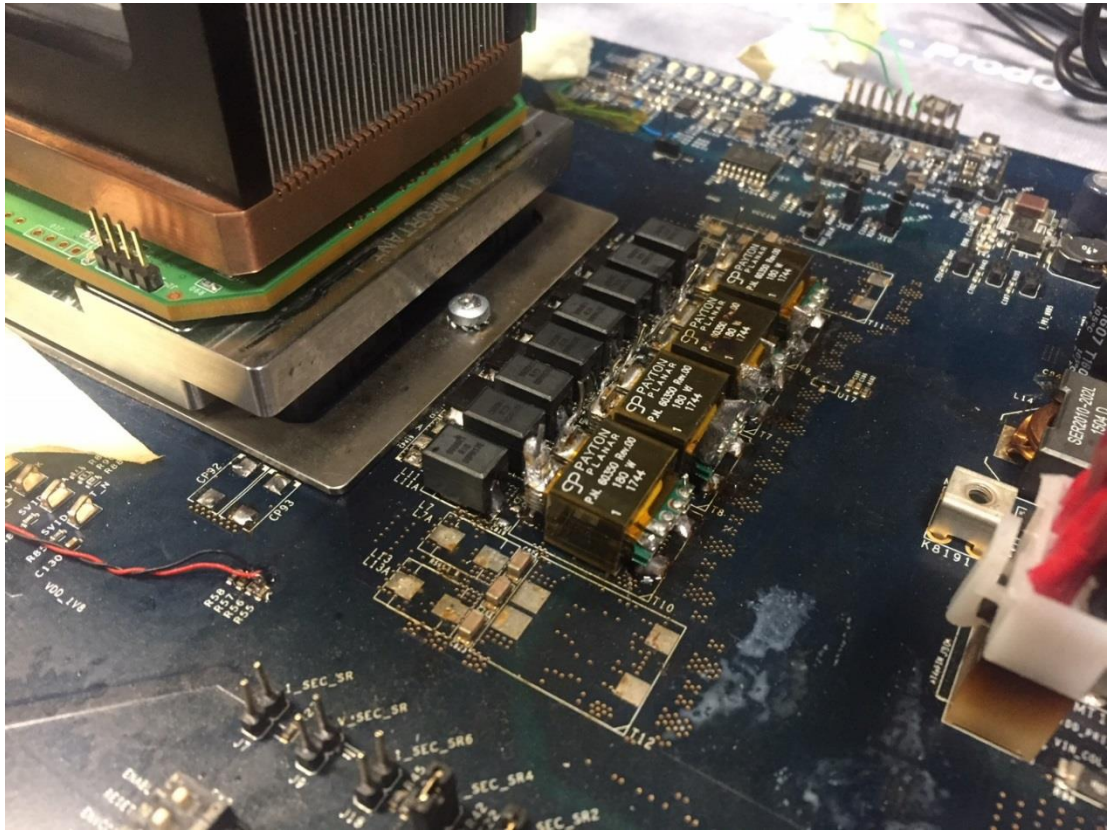
54V to CPU, VR13.HC – 205W TDC

Resonant Design

93%+ Peak and Flat Efficiency, Cell Shedding

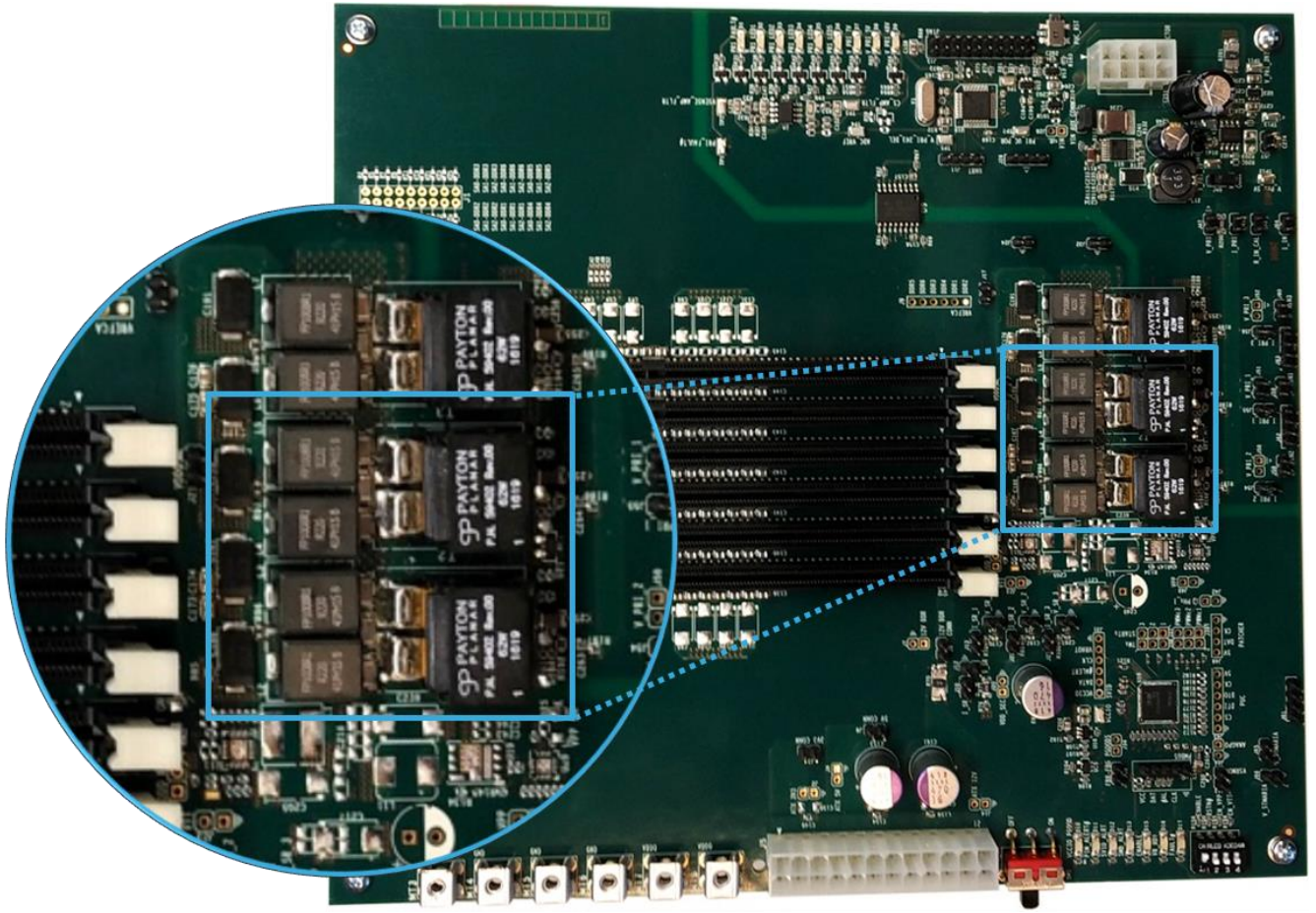




DDR4 Reference Design

93.2% Peak and Flat Efficiency, 2 Cell Shedding

Specifications	
V_{IN}	40V to 60V ($54V_{TYP}$)
V_{OUT}	1.2V +/-1%
P_o	150W (@V_{IN}=40V)
Output current	125A (@V_{IN}=40V)
Frequency of operation	215KHz (@V_{IN}=54V)
Power density	71W/inch^2
Actual Peak Efficiency	93.2%
Load and Line regulation	<0.1%
Solution size (Active area)	2.1 inch2



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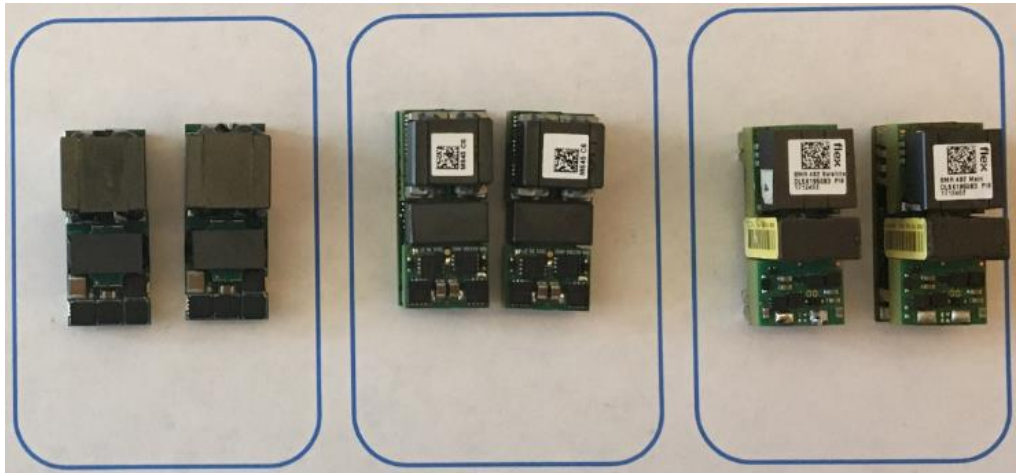
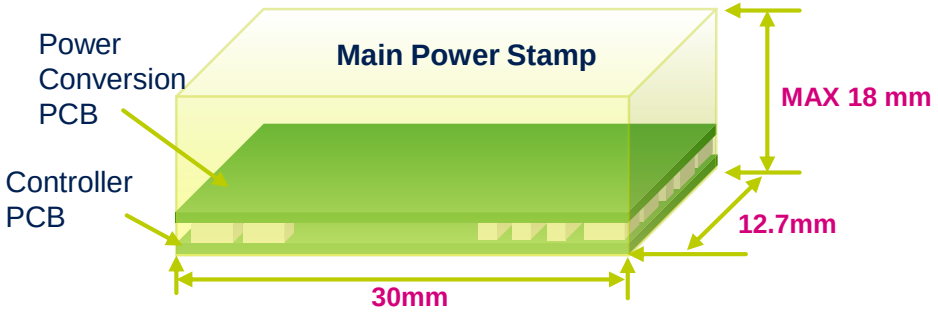
Power Stamp Alliance (PSA)

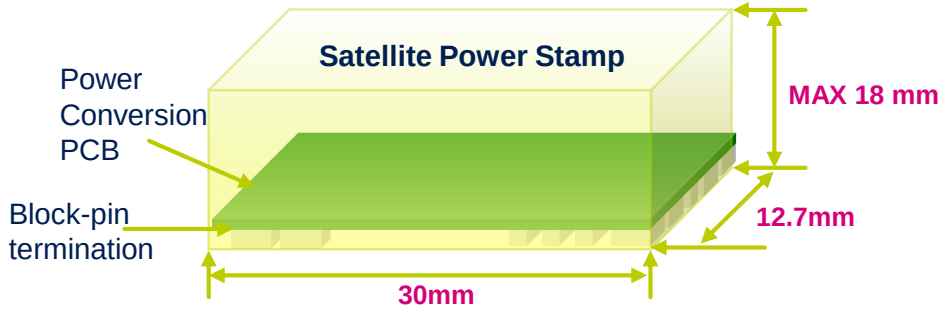
Power Stamp Alliance Defines a standard product footprint and functions that provide a multiple-sourced, standard modular board-mounted solution for power conversion for 48Vin to low-voltage, high-current applications.

- Multiple-sourced standard footprint units for CPU, DDR, ASIC, among others.
- All members have high-volume manufacturing capability with industry-standard processes and components.
- Energy Proportional, the operating units are automatically optimised to the load required for optimal efficiency.
- Has been mechanically and electrically sized to meet the demands of server applications.
- PMBus AVS and SVID Compliant



100 A/cell





12V CPU & DDR Power Delivery

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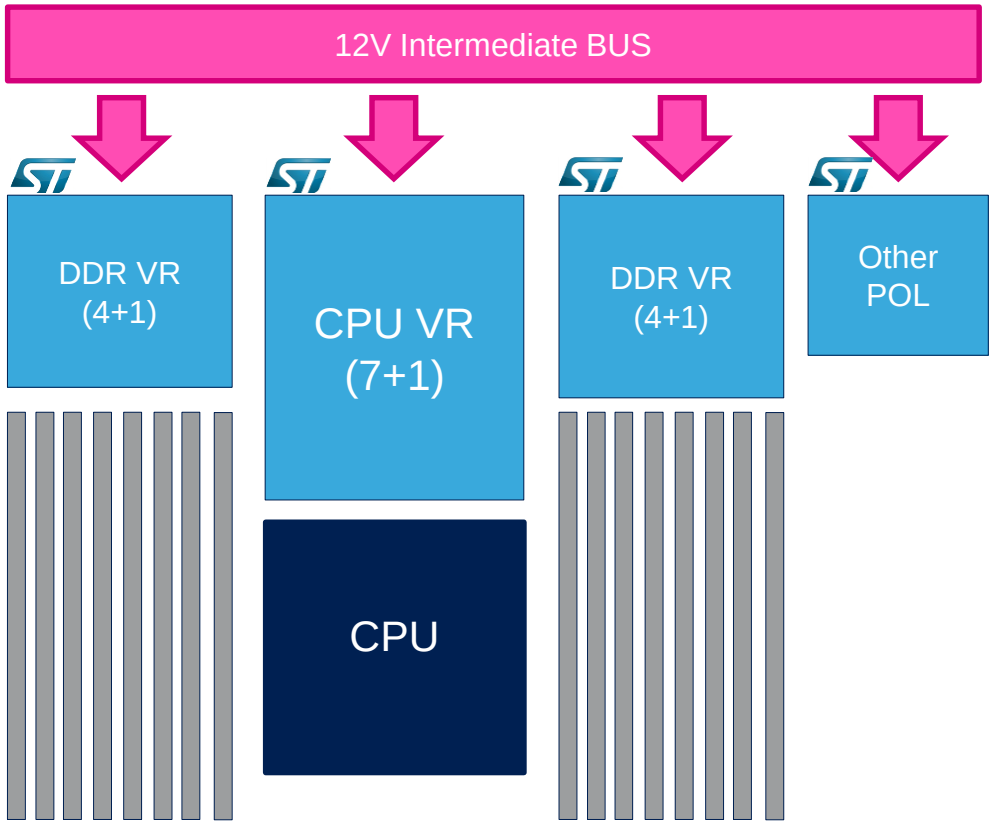
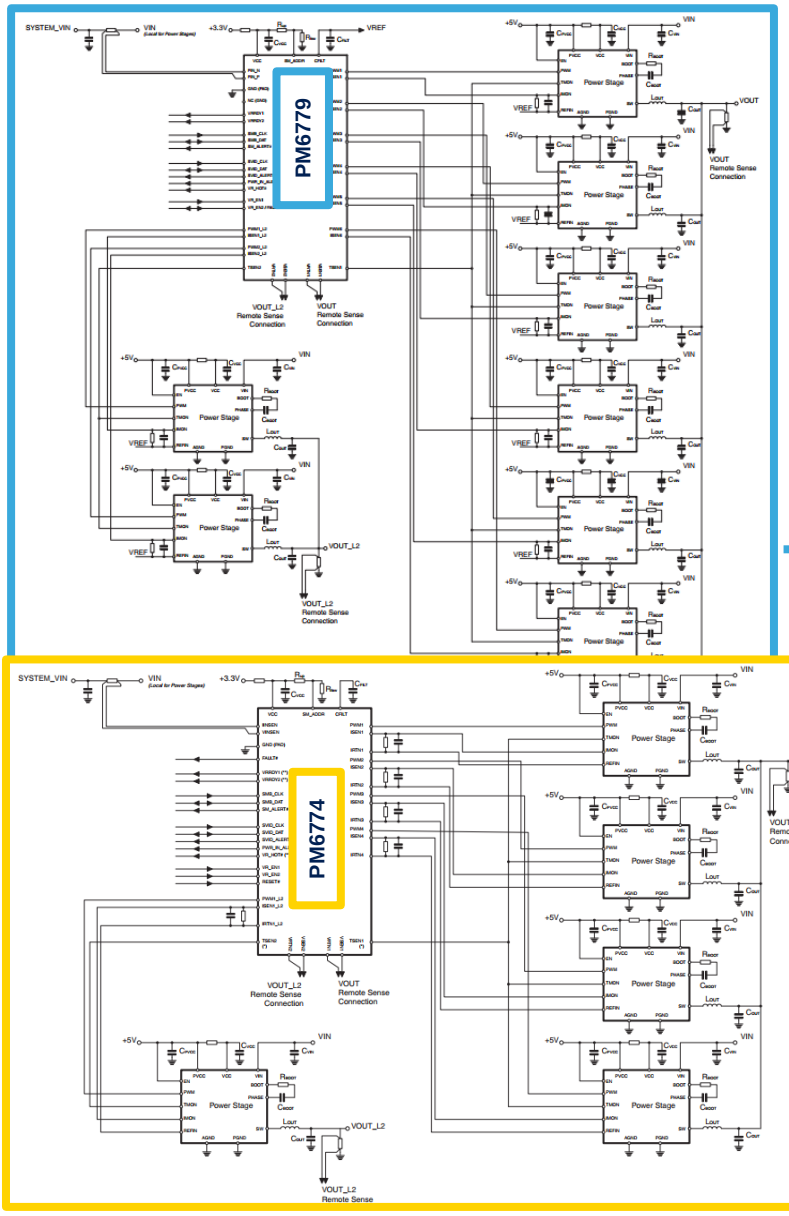
Digital Power Distribution from 12V Bus

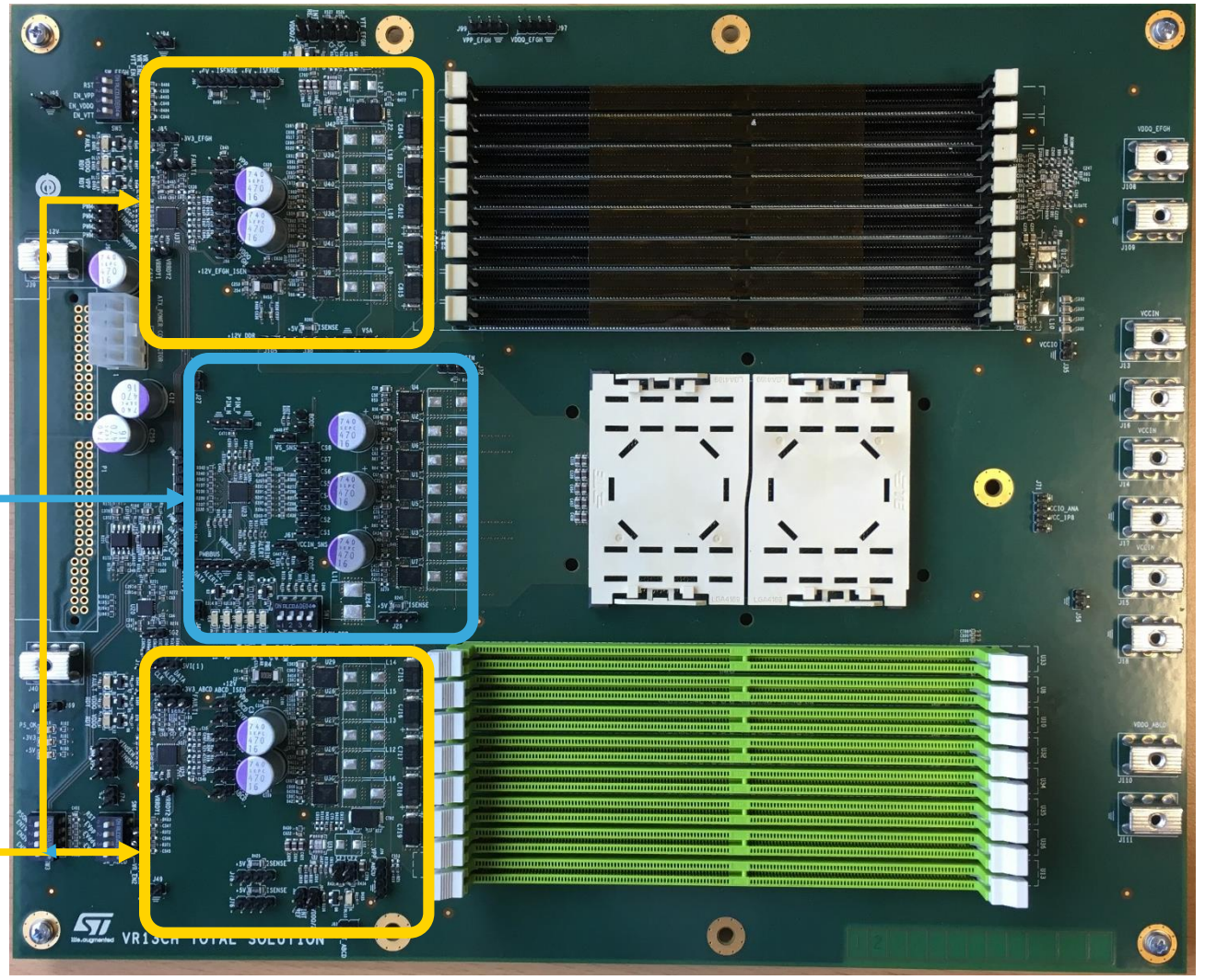
Complete Multiphase Digital Solution for CPU and DDR



- 12V Input Voltage, Vout range: 0.5 to 2.5 V
- CPU and DDR Power Distributuion
- PMBusTM rev 1.2 at 400 kHz
- High-Performance Digital Control Loop (Digital STVCOTTM)
- Autonomous Dynamic Phase Shedding
- Remote Sense with <0.5% Vout Accuracy
- Current monitor signal with calibration
- Programmable Voltage Positioning
- OV, UV and FB Disconnection Protection

PM6779/4: VR13.HC (P+ STK, 8 DIMM)





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Summary

- Power Demand from Digital ASICs (CPU, GPU, TPU) is Rising
- 12V Power Distribution Bus is Exhibiting Some Limitations
- 48V (54V) Power Distribution Provides Better Overall Efficiency
- Several Architectures Are Available to Distribute Power from 48V
  - Two Step Conversion: Unregulated (STC) or Regulated (STB)
  - Direct Single Step Conversion (Power Stamp Alliance)
- Each Solution Offers Different Benefits Allowing to Optimize System Power Delivery Based on Specific Design Priorities

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Thanks!