



GaN and the 800 V AI Data Center Architecture Power Delivery Board (PDB)

Gianni Vitale and Jeff Halbig

Analog, Power Discrete, MEMS, and Sensors

Marketing and Applications
STMicroelectronics

Agenda

1 Data Center Power Architecture Evolution

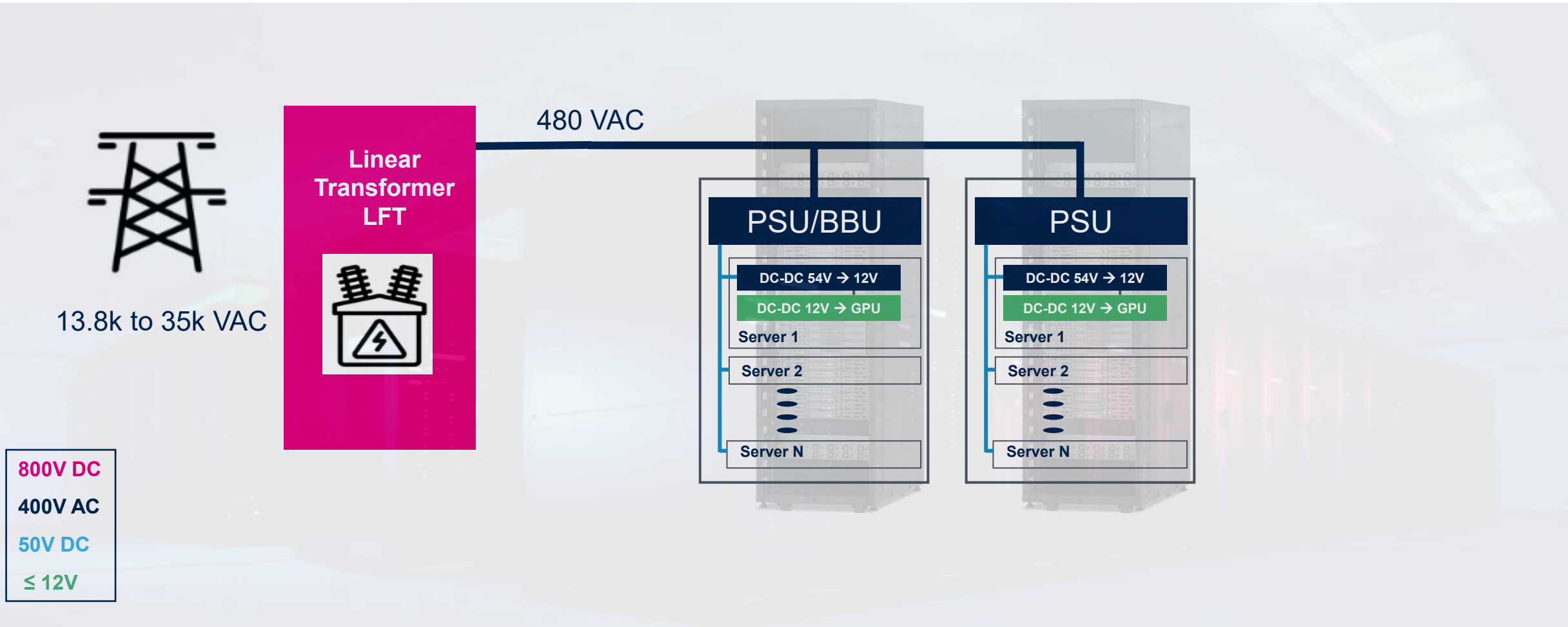
2 800V PDB design and implementation

3 STPOWER GaN Family

4 Takeaways

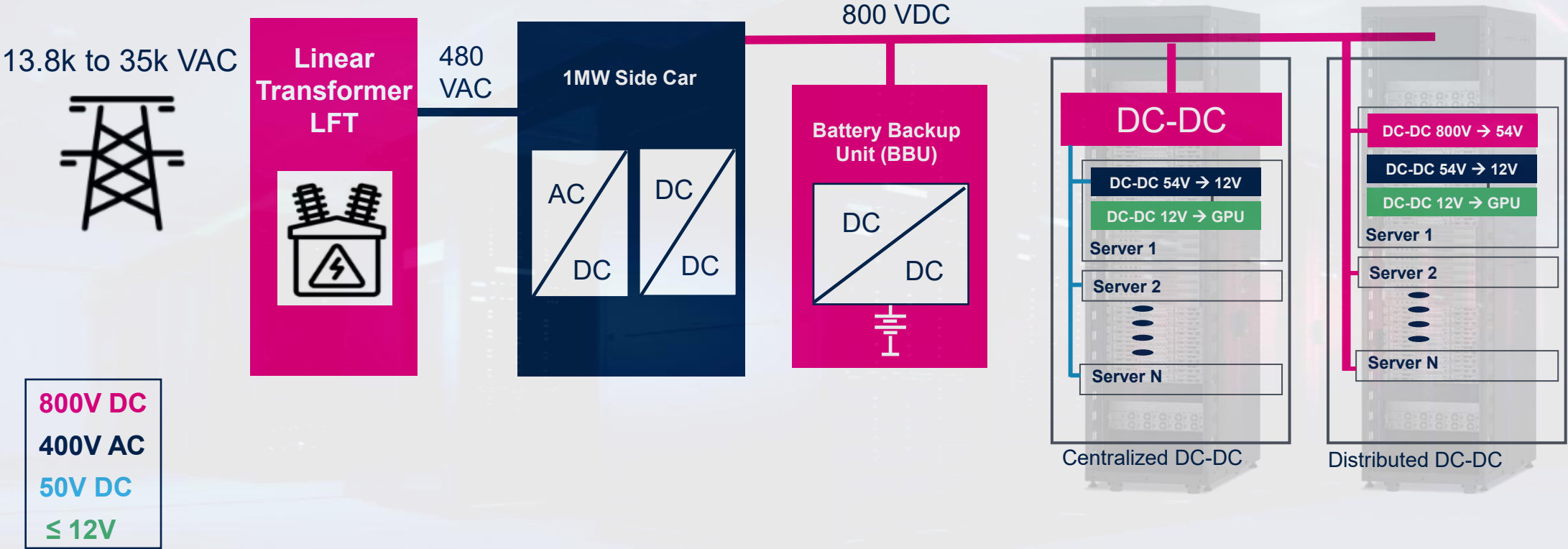


Traditional Data Center Architecture

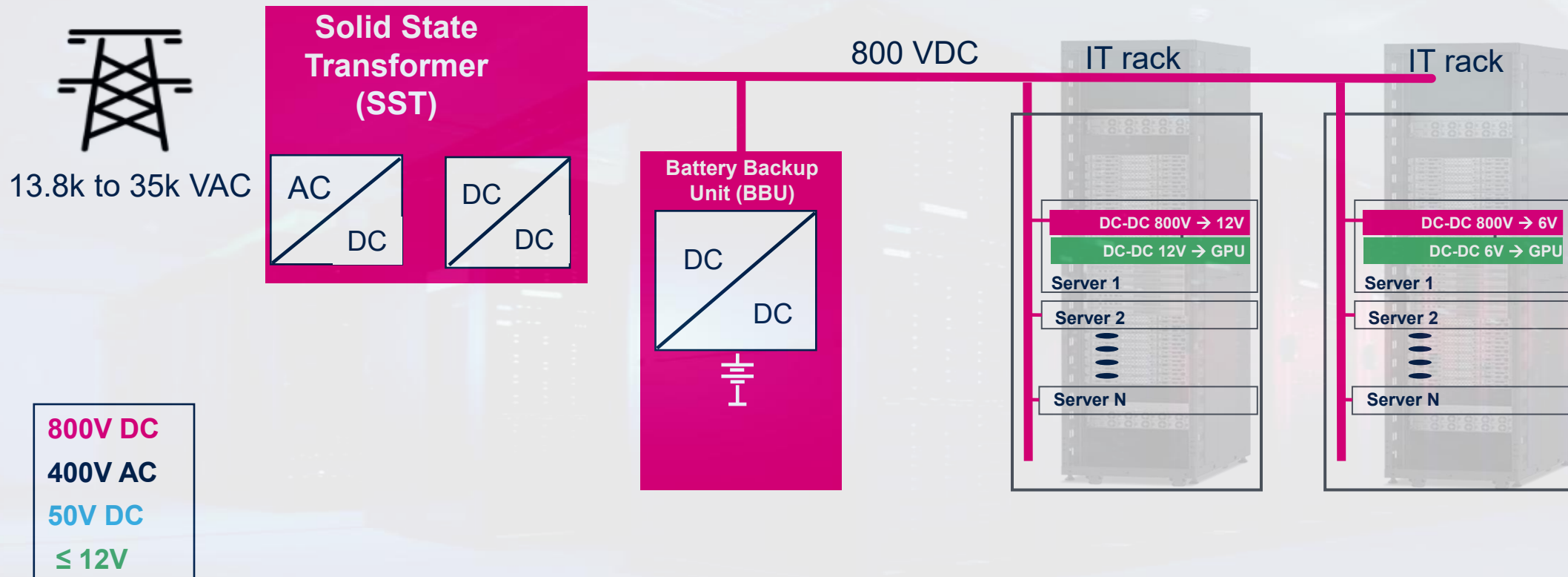


PSU: Power Supply Unit
BBU: Battery Backup Unit

Medium-term AI Data Center Architecture



Long-term AI Data Center Architecture





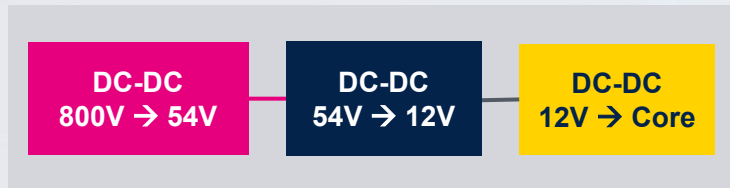
Design and implementation of 800V PDB



800V Power distribution options

800V → Core (3 Stages Conversion)

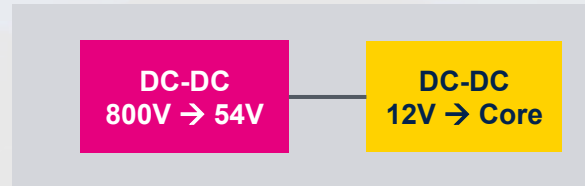
IT Server Rack



- Input range: 800 V (± 100 V)
- Fully isolation between primary and secondary side
- Output range: Unregulated 16:1 - 50V (56.25 V – 43.75 V)
- Total power: **12 kW TDP** (2 outputs 6 kW each)
- Efficiency: $\geq 98\%$ at full load
- Liquid cooled
- Total height ≤ 10 mm (without heatsink)
- 2600W/inch³

800V → Core (2 Stages Conversion)

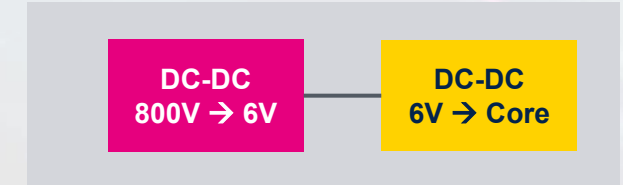
IT Server Rack



- Input range: 800 V (± 100 V)
- Fully isolation between primary and secondary side
- Output range: Unregulated 64:1 - 12.5V (10.9V - 14.0V)
- Total power: **6 kW TDP**
- Efficiency: $\geq 97\%$ at full load
- Liquid cooled
- Total height ≤ 10 mm (without heatsink)
- 2000W/inch³

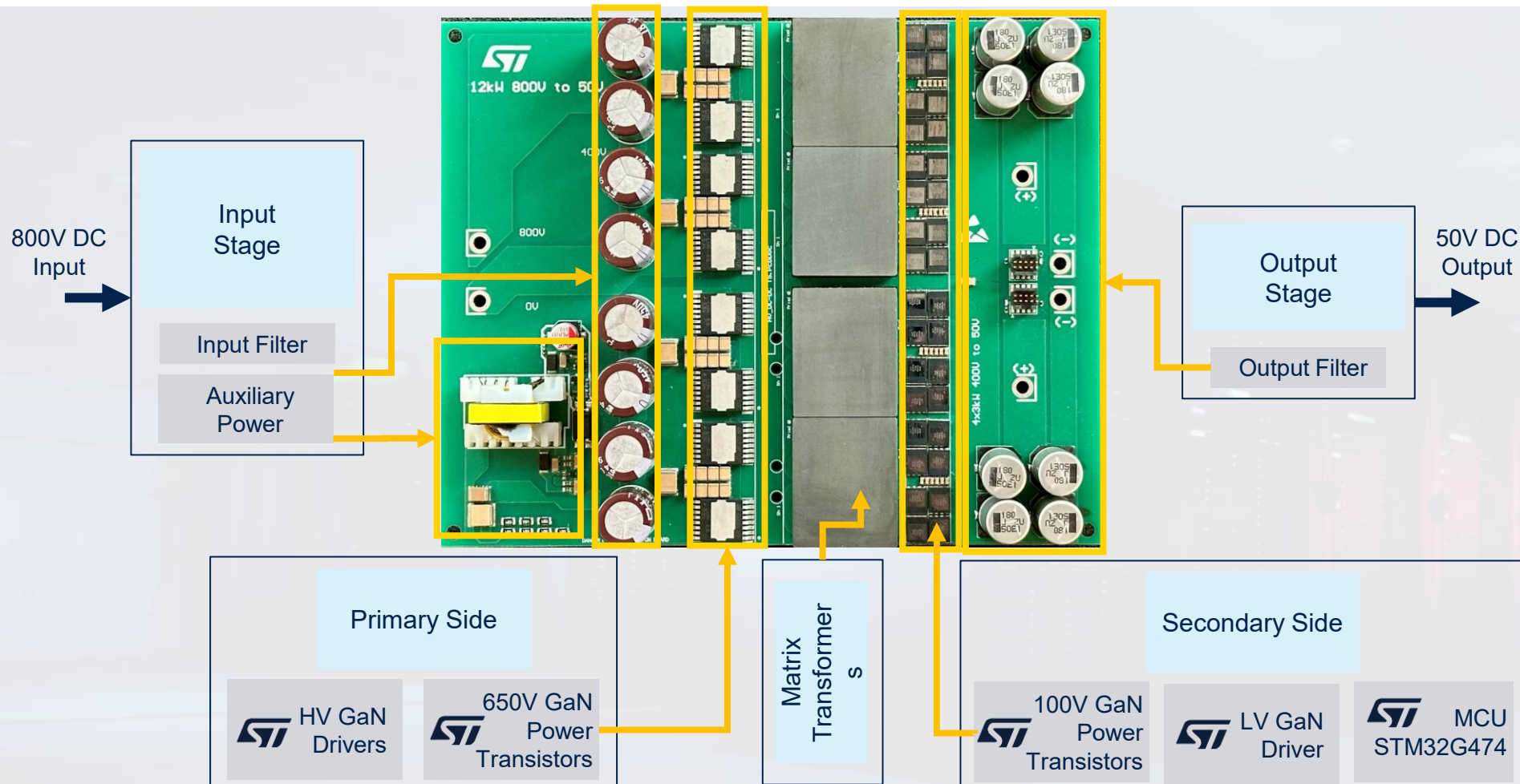
800V → Core (2 Stages Conversion)

IT Server Rack



- Input range: 800 V (± 100 V)
- Fully isolation between primary and secondary side
- Output range: Unregulated 128:1 – 6.25V (5.45V - 7V)
- Total power: **20 kW TDP**
- Efficiency: $\geq 96.5\%$ at full load
- Liquid Cooled
- Total height ≤ 6 mm (without heatsink)
- 2300W/inch³

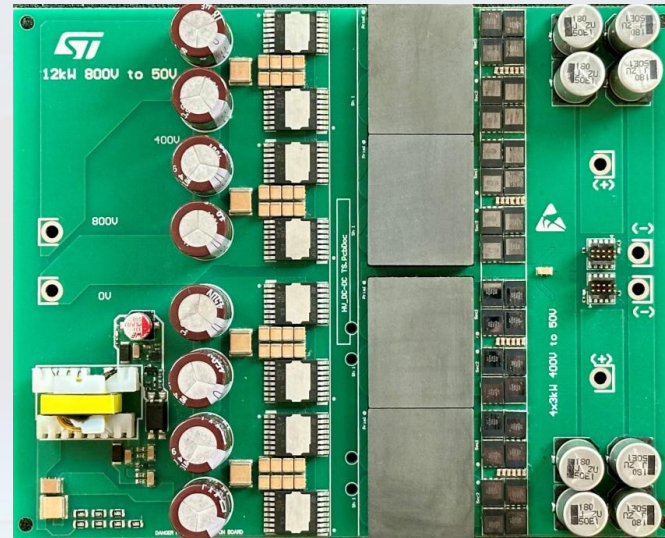
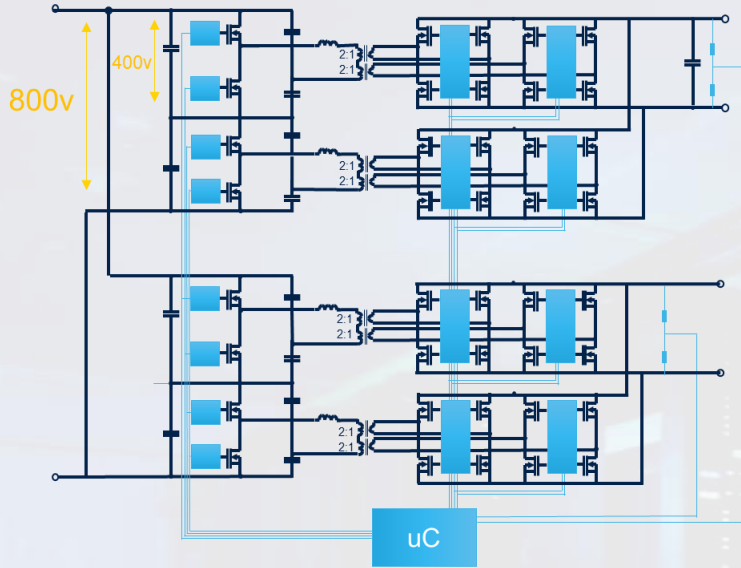
12 kW HVDC converter: 800 V to 50 V



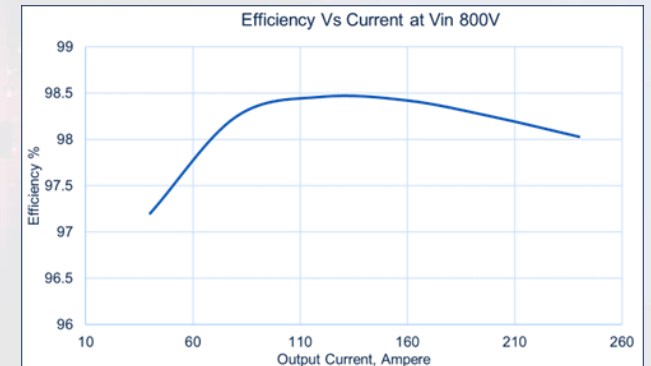
800V to 50V

- **STM32G474VEH3**: Arm Cortex-M4 Digital Power MCU in BGA100 10x10mm
- **SGT023R70FTP**: 700 V, 18 mΩ typ in TOLT
- **STGAP2G** Galvanically isolated 3 A single gate driver for GaN FETs in Wide body SO-8W package
- **SGT1D5R10MEA** is a 1.1 mΩ typ RDS(on), 100 V eGaN® power transistor in a low inductance En-FCQFN 5x6
- **STPRDC02GN**: 60V full-bridge driver for GaN and silicon in a VFQFPN, 4x4 package
- **L6565**, QUASI-RESONANT SMPS controller
- **STH12N120K5-2**, 1200V/690mΩ in H2PAK-2

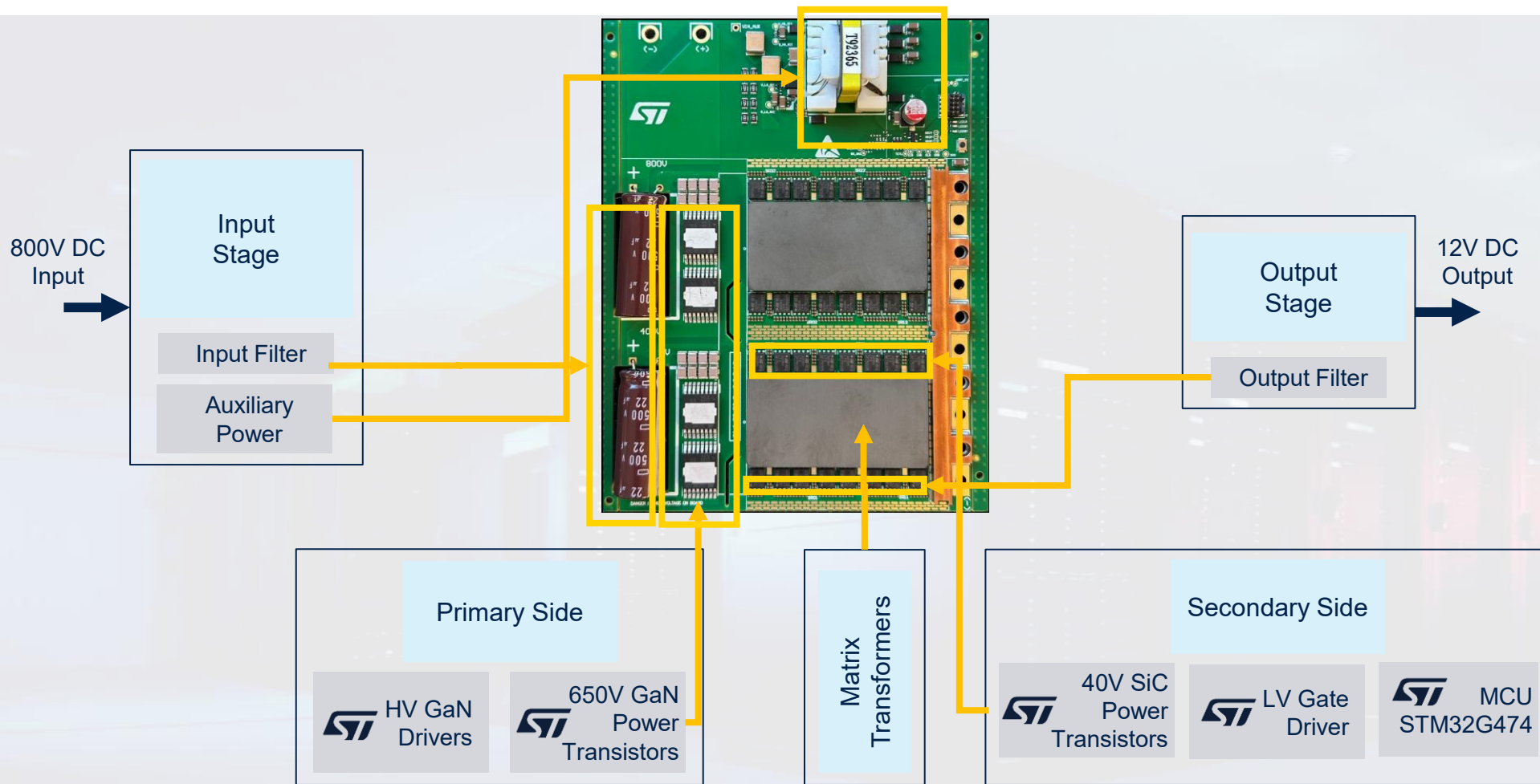
800V to 50V → 12 kW-DCX 16-1



Parameter	Value / Range
Input Voltage	750-850V
Conversion Ratio	16:1
Output Voltage	50V
Total output Power	12kW
Single LLC Power	3kW
Switching Frequency	1MHz
Power Density	2600 W/in ³
Target Efficiency @ Full power	98%
Control	Fixed Frequency/ Unregulated
Cooling	Liquid



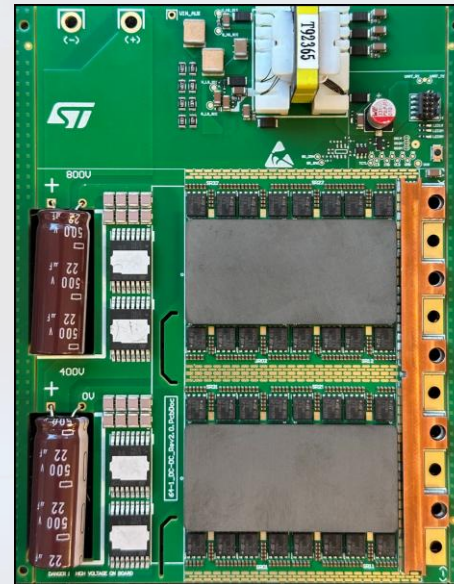
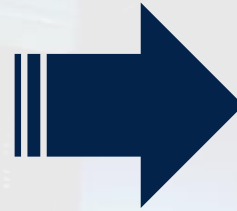
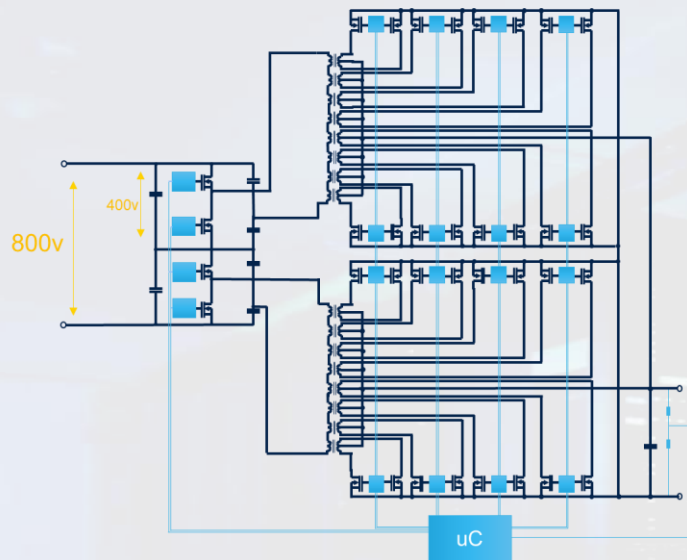
6 kW HVDC converter: 800 V to 12 V



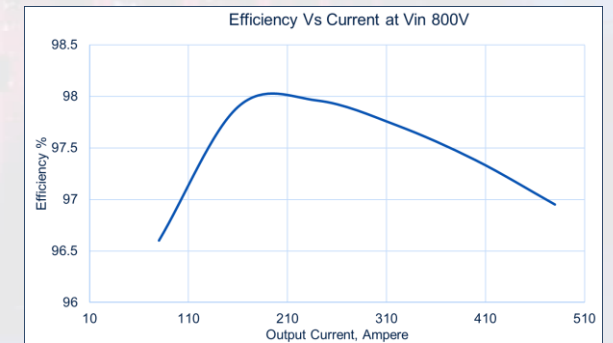
800V to 12V

- **STM32G474VEH3**: Arm Cortex-M4 Digital Power MCU in BGA100 10x10mm
- **SGT023R70FTP**: 700 V, 18 mΩ typ in TOLT
- **STGAP2G** Galvanically isolated 3 A single gate driver for GaN FETs in Wide body SO-8W package
- **STL320N4F8**: 0.85 mΩ max RDS(on), 40 V in PowerFLAT 5x6
- **STPRDC02GN**: 60V full-bridge driver for GaN and Silicon in a VFQFPN, 4x4 package
- **L6565**, QUASI-RESONANT SMPS controller
- **STH12N120K5-2**, 1200V/690mOhm in H2PAK-2

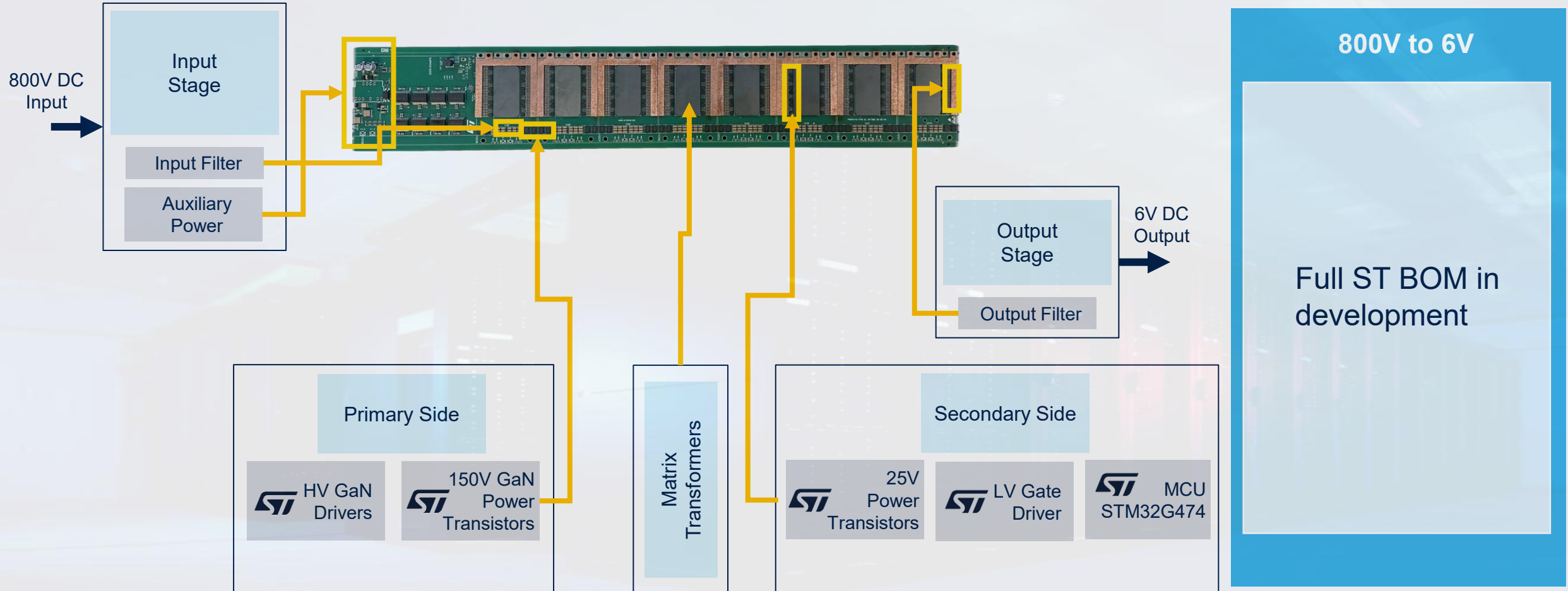
6 kW-DCX 64-1



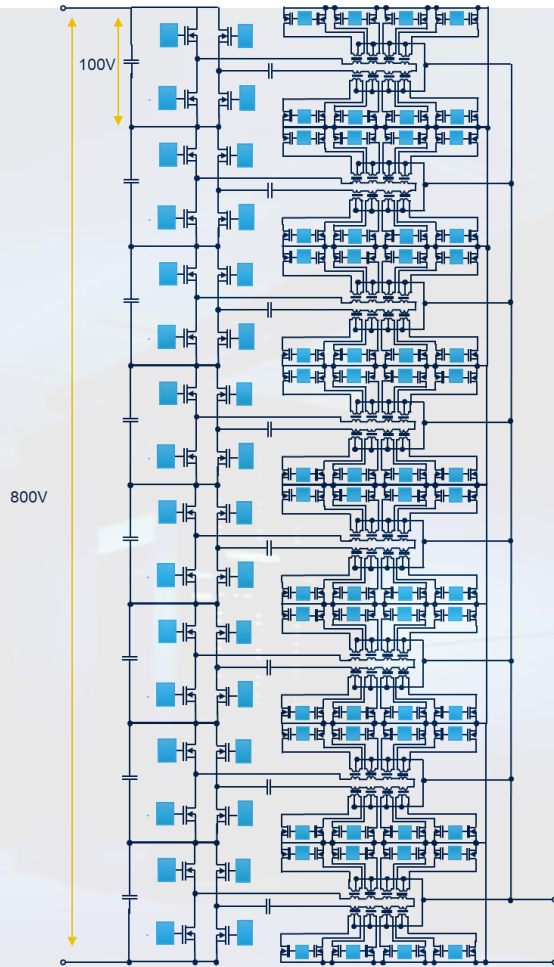
Parameter	Value / Range
Input Voltage	750-850V
Conversion Ratio	64:1
Output Voltage	12.5V
Total output Power	6kW
Single LLC Power	3kW
Switching Frequency	850 KHz
Power Density	2000 W/in ³
Target Efficiency @ Full power	97%
Control	Fixed Frequency/ Unregulated
Cooling	Liquid



20 kW HVDC converter: 800 V to 6 V



20 kW HVDC converter -DCX 128-1



800V Power distribution options

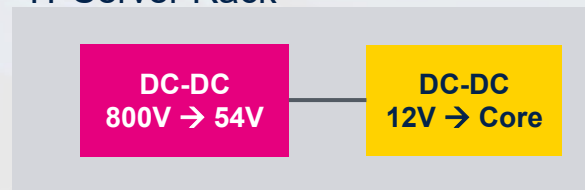
800V → Core (3 Stages Conversion)

IT Server Rack



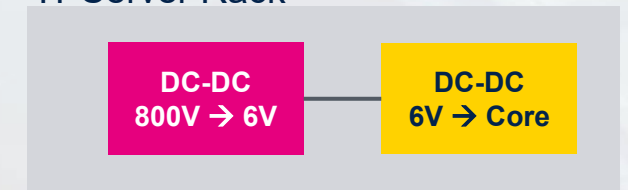
800V → Core (2 Stages Conversion)

IT Server Rack

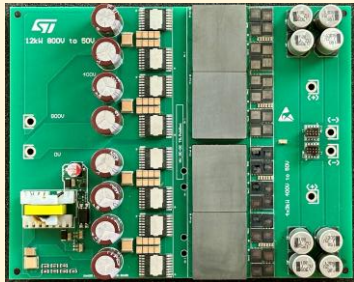


800V → Core (2 Stages Conversion)

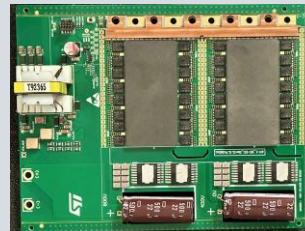
IT Server Rack



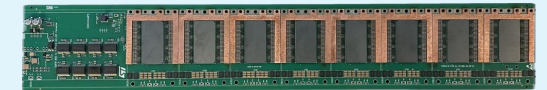
800V to 50V BOM



800V to 12V



800V to 6V



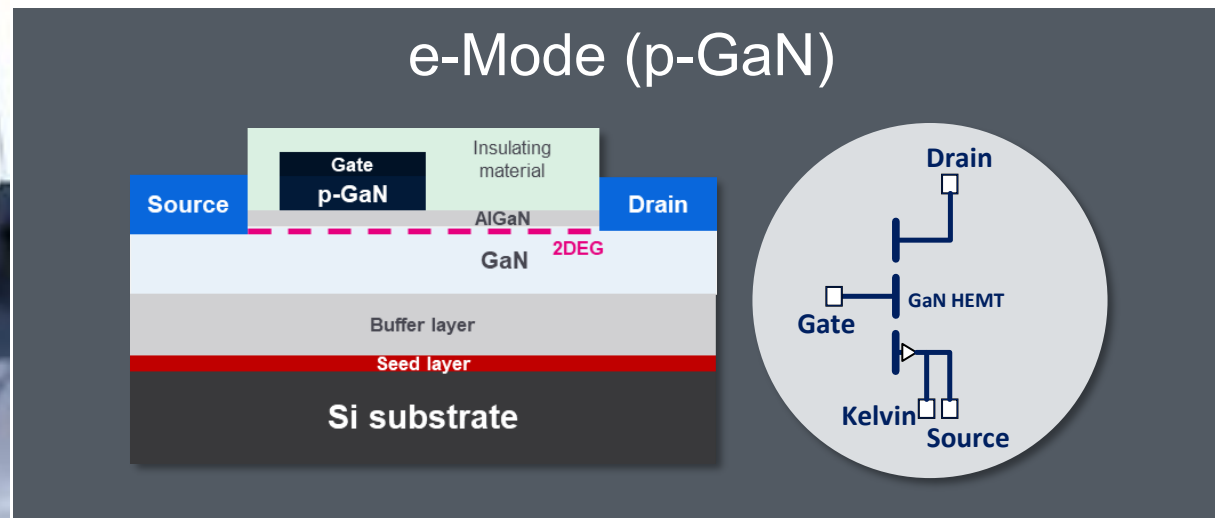
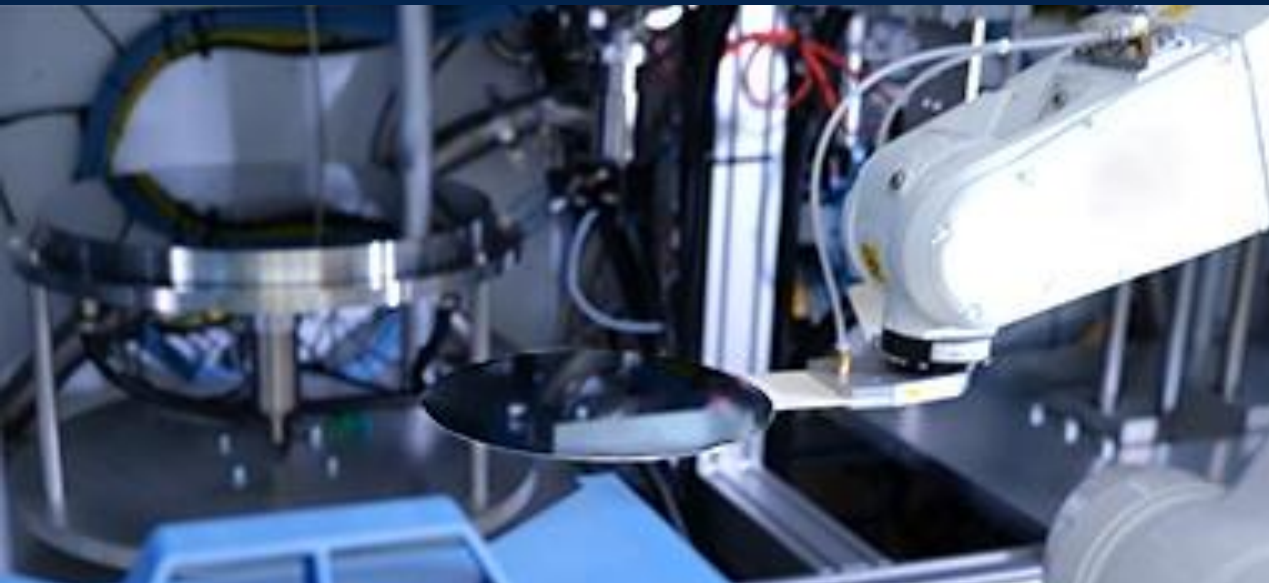


New STPOWER GaN



STPOWER GaN technology platforms

GaN-on-Silicon normally-off, based on p-GaN process



- Towards 8-inch wafers in-house manufacturing with vertically integrated process from GaN epitaxy to power device for LV/MV/HV
- Reliable supply chain
- Product differentiation through proprietary technology

STPOWER GaN

FE manufacturing footprint Diversification



Existing Partner FE foundry sources and Activation of ST Italy (Catania) as new FE source started in Q2'25



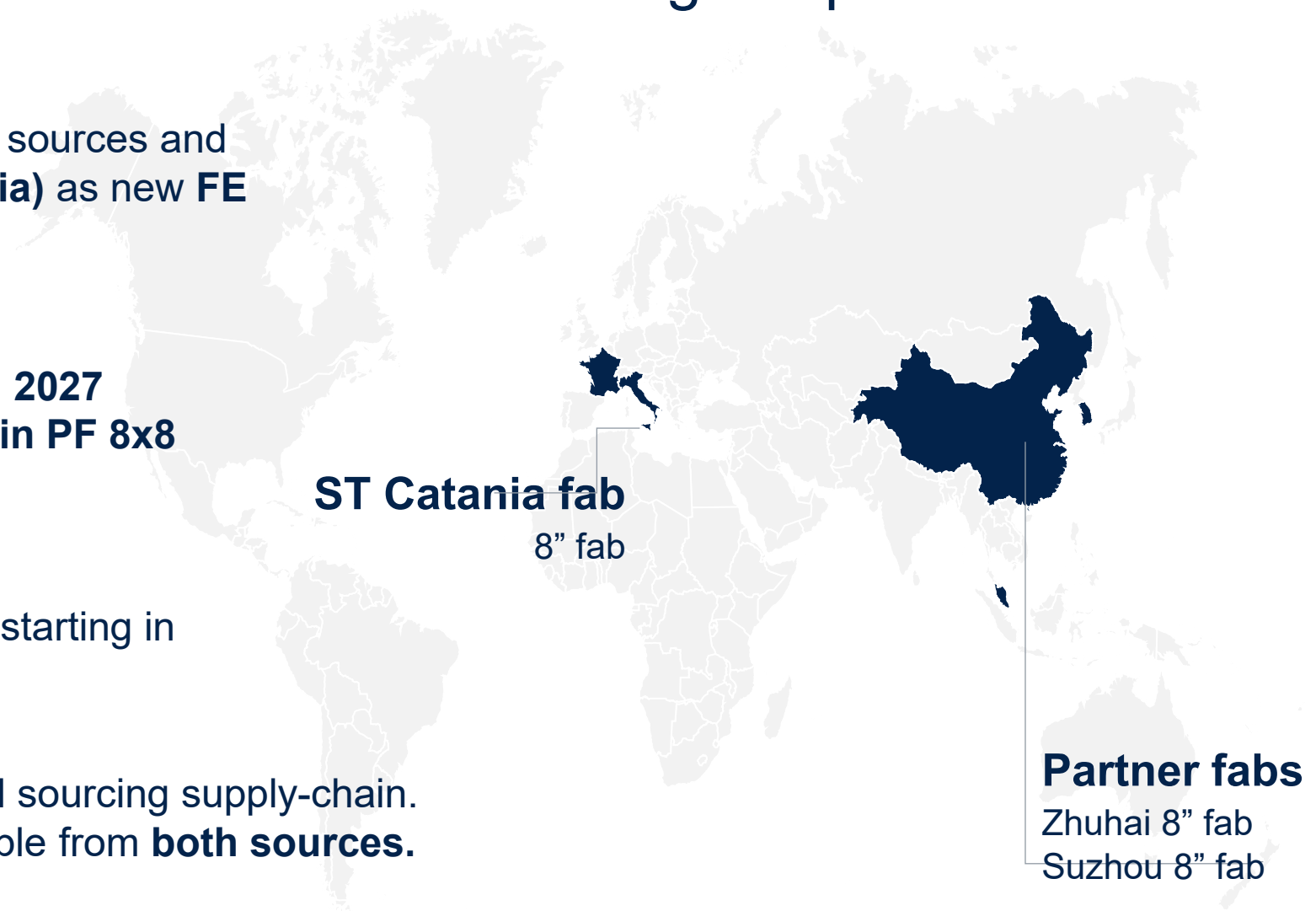
ST Italy (Catania)
Starting full production in **Q1 2027**
First product: **700V 130 mΩ in PF 8x8 Industrial grade**



ST Italy (Catania)
Automotive grade products starting in 2028



ST offering full decoupled dual sourcing supply-chain. Same products will be available from both sources. BE OOC in qualification



RDSon max mΩ

#7 parts in full production

700V in PowerFLAT 8x8

- 240mΩ
- 190mΩ
- 140mΩ
- 105mΩ
- 80mΩ



700V 350mΩ in DPAK



700V 70mΩ in TOLL



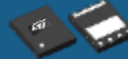
#13 parts planned in 2026

700V



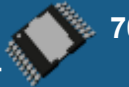
- 240mΩ in DPAK
- 350mΩ in die form

700V



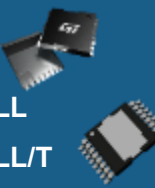
- 130mΩ in PowerFLAT 5x6
- 100mΩ in PowerFLAT 5x6
- 210mΩ in die form

700V



- 23mΩ in TOLL

700V



- xxmΩ in TOLL
- xxmΩ in TOLL/T
- xxmΩ in TOLL (BDS)
- xxmΩ in QDPAK (BDS)

100V



- 1.5mΩ in EN-FCLGA 5x6
- 3.5mΩ in EN-FCLGA 3.3x3.3



Robotics



Consumer



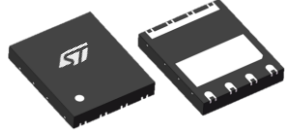





Datacenter




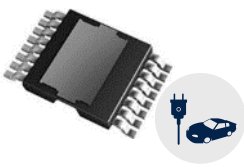
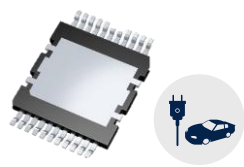
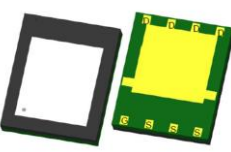
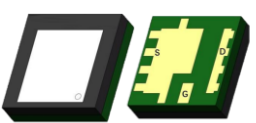



Power & Energy



Packages for STPOWER GaN

	PowerFLAT 5x6 BSC	PowerFLAT 8x8 BSC	TO252-DPAK
Package			
Characteristics	<ul style="list-style-type: none"> • Smallest footprint for HV GaN • TAB connected to SOURCE • Low package profile • 5.00 x 6.00 x 0.85 mm • Multiple sources • Kelvin source pin for optimized driving 	<ul style="list-style-type: none"> • Larger exposed metal on bottom side • TAB connected to SOURCE • Low package profile • 8.00 x 8.00 x 0.90 mm • Multiple sources • Kelvin source pin for optimized driving 	<ul style="list-style-type: none"> • Cost effective solution • TAB connected to SOURCE • Well establish industry standard • 6.60 x 10.10 x 2.30 mm • Multiple sources • No Kelvin source pin
Applications	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>Gaming & Adapter</p> </div> <div style="text-align: center;">  <p>LED Lighting</p> </div> <div style="text-align: center;">  <p>Server and Telecom Power</p> </div> </div>		

Packages for STPOWER GaN

	TO-LL	TOLT	QDPAK	EN-FCLGA 5x6	EN-FCLGA 3.3x3.3
Package					
Characteristics	<ul style="list-style-type: none"> ❑ Flexible solution ❑ TAB connected to SOURCE ❑ Well established in server and telecom ❑ 9.9 x 11.68 x 2.30 mm ❑ Multiple sources ❑ Kelvin source pin for optimized driving 	<ul style="list-style-type: none"> ❑ Exposed metal on top ❑ TAB connected to SOURCE ❑ Unidirectional and bidirectional ❑ 10 x 15 x 2.30 mm ❑ Multiple sources ❑ Kelvin source pin for optimized driving 	<ul style="list-style-type: none"> ❑ Exposed metal on top ❑ Suitable for High power low Ohmic ❑ Unidirectional and bidirectional ❑ 15 x 20.96 x 2.30 mm ❑ Multiple sources ❑ Kelvin source pin for optimized driving 	<ul style="list-style-type: none"> ❑ Exposed metal on top and bottom ❑ Bottom TAB connected to DRAIN ❑ Pin to pin with Si MOSFETs ❑ 5 x 6 x 0.87 mm ❑ Package level 	<ul style="list-style-type: none"> ❑ Exposed metal on top and bottom ❑ Bottom TAB connected to SOURCE ❑ Pin to pin with Si MOSFETs ❑ 3.3 x 3.3 x 0.87 mm ❑ Package level
Applications	 <p style="text-align: center;">Server and Telecom Power</p>		 <p style="text-align: center;">OBC & DC-DC Converter</p>		 <p style="text-align: center;">Power & Energy</p>

GaN based 800V Power Distribution Boards

12kW Full Brick form factor for 800V to 50V conversion at > 98.5% efficiency and 2.6kW/in³ power density

- Increasing power requirements for the server rack requires a fundamentally new approach based on a +/- 400V or 800V bus
- Advances in Power GaN transistors and packaging, coupled with novel magnetics design, are fundamental to reaching unprecedented power density for DC-DC conversion at 800V inputs
- Solution is scalable to higher ratios of input:output voltage to streamline total power chain
- STMicroelectronics application know-how and complete portfolio of analog, digital, and power components enable a full reference design

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