

ASPENCORE

POWERUP

CONFERENCE & EXPO

FORTRONIC

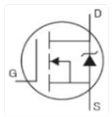
Robust GaN Power ICs Drive into High-Power, High- Reliability Systems

September 19 | 13:40



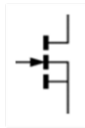
Alessandro Squeri
European Sr. Director Sales
Navitas

Si MOSFET



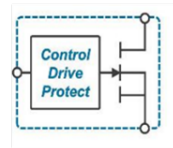
- Old, slow
- High Q_g
- High C_{oss}
- $F_{sw} < 100$ kHz

Discrete GaN



- dV/dt sensitivity
- Layout sensitivity
- ESD sensitivity
- Unknown reliability

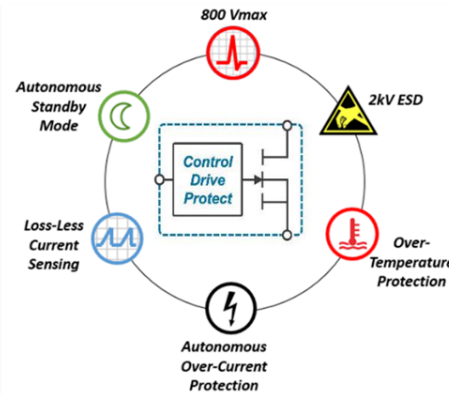
GaNFast™



GaNFast:

- ✓ Internal Gate
- ✓ Integrated Gate Drive
- ✓ dV/dt Immunity
- ✓ Layout Insensitive
- ✓ 2 kV ESD rating
- ✓ Proven Reliability
- ✓ Proven Robustness

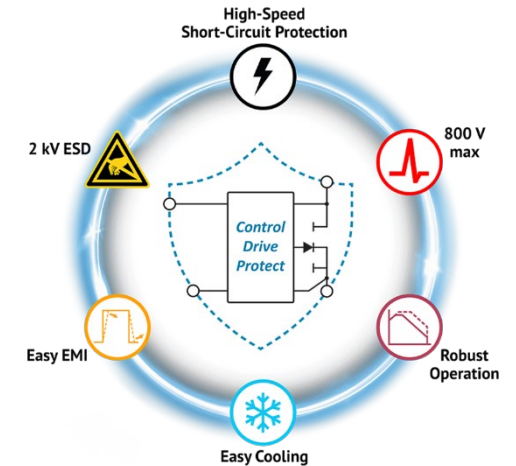
GaNSense™



GaNFast plus:

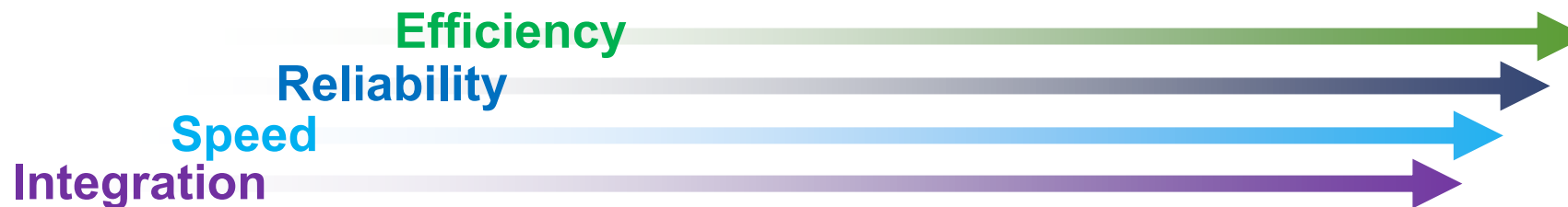
- ✓ Autonomous Standby
- ✓ Autonomous Protection
- ✓ Loss-less Current Sensing
- ✓ High Precision
- ✓ High Efficiency

GaNSafe™

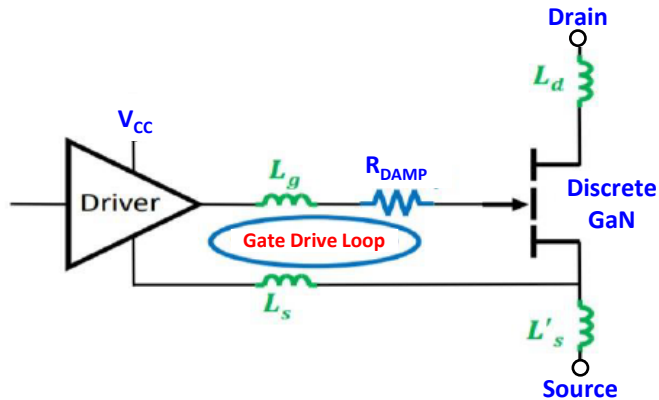


GaNSense plus:

- ✓ Desat detect Short Circuit Protection with ultra-fast 350ns / 50ns latency
- ✓ Robust, thermally enhanced packaging: ultra-low $R_{\theta JUNC-AMB}$ and BLTC Reliability
- ✓ 4th Gen integrated GaN gate drive with positive TempCo V_{GS} regulation
- ✓ Integrated Miller Clamp (no negative gate bias, higher 3rd quadrant efficiency)
- ✓ Programmable dV/dt Turn-ON/OFF slew rate control for ease of design



GaNFast™ to GaNSafe™: Max 4th-Gen Reliability



Discrete GaN = *high risk*, high gate loop inductance

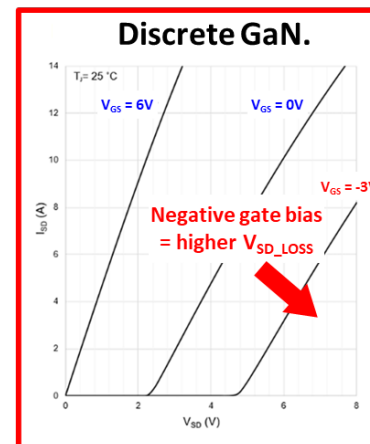
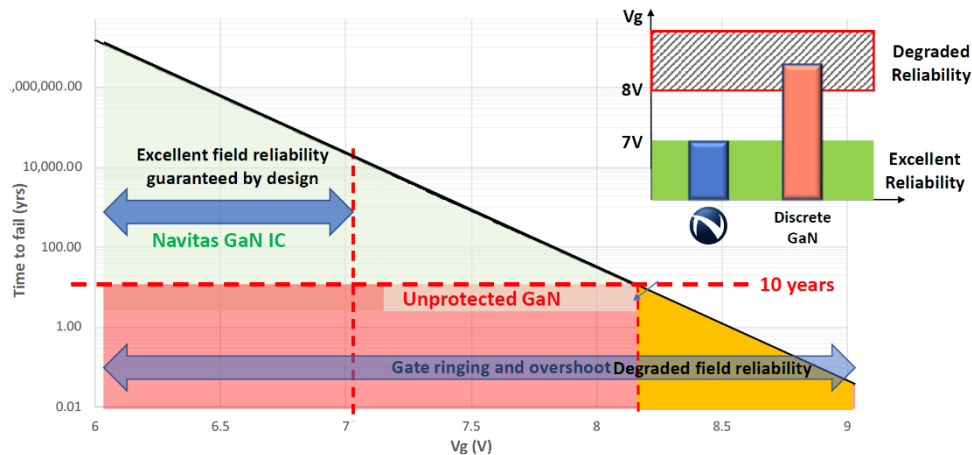
- Shoot-thru risk multiplied by increased di/dt in high-power applications

GaNFast™: integrated, regulated gate drive, zero loop inductance

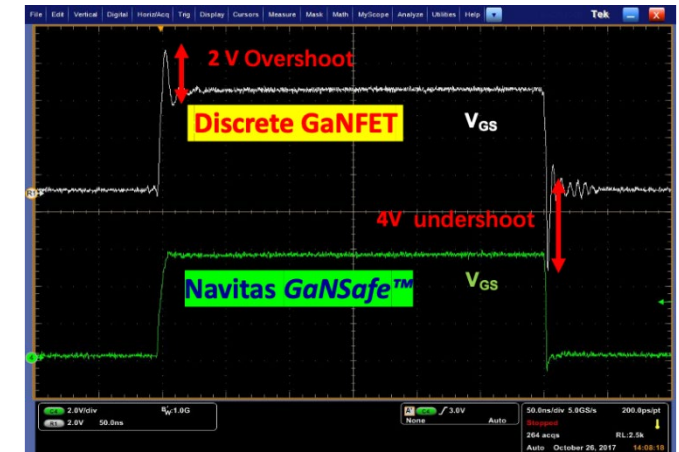
- Higher efficiency, lower system cost, fewer components, smaller PCB

GaNSafe™: optimized for high power

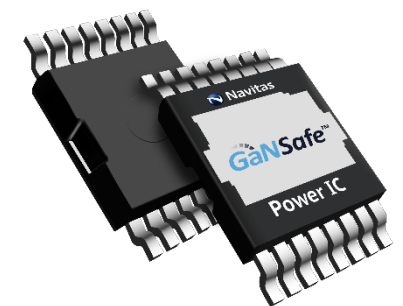
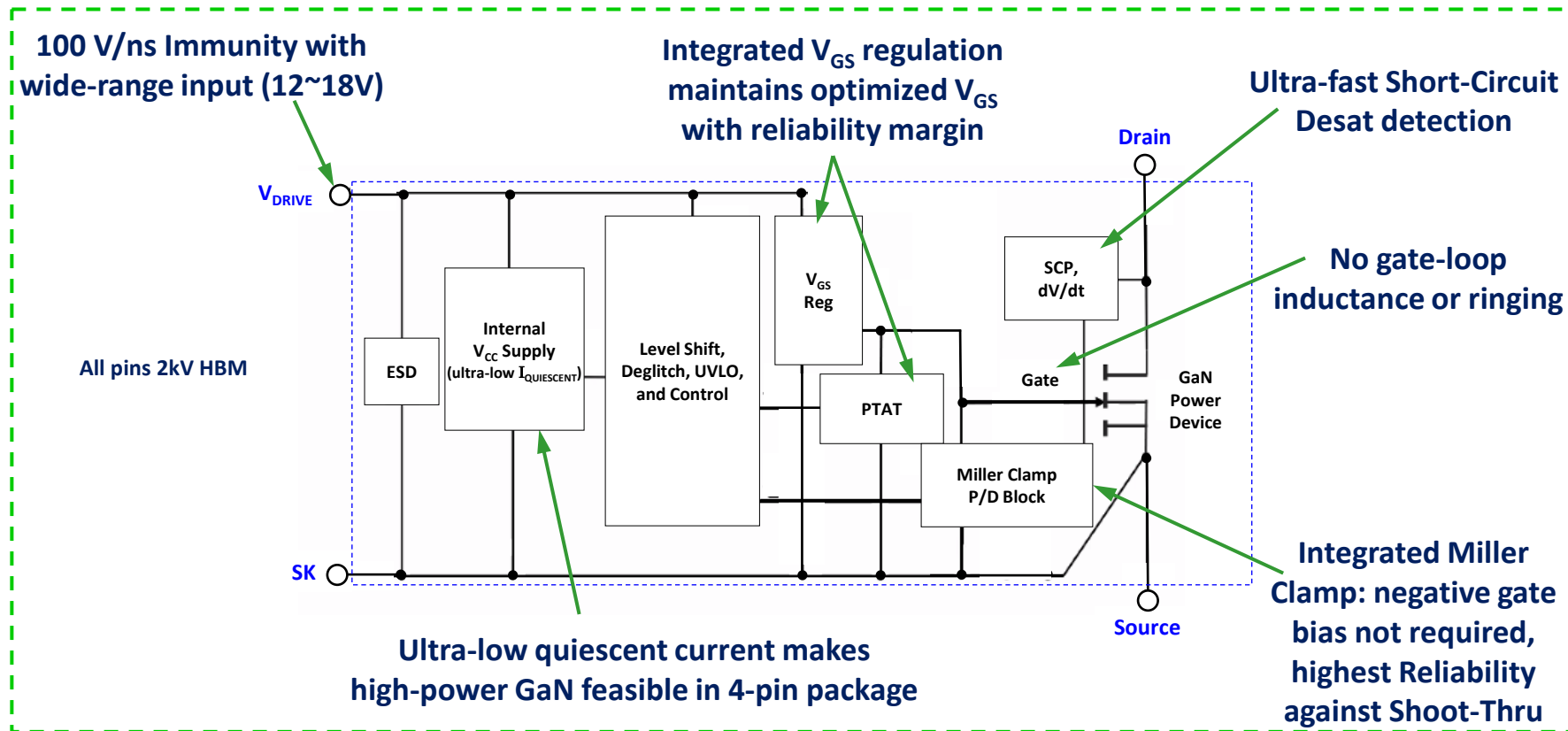
- More protection (350 ns Desat SCP, UVLO, ESD, etc.)
- More control (dV/dt ON & OFF, etc.)
- Industry-standard, robust, cool packaging



Discrete GaNFET vs. GaNSafe™.



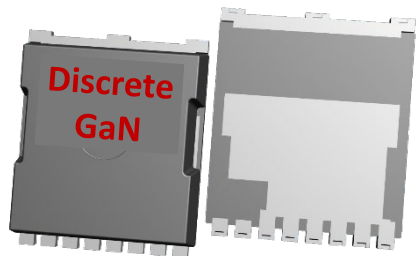
GaNSafe™: Reliable High-Power GaN in 4 Pins



GaNSafe™ Delivers High-Power Reliability

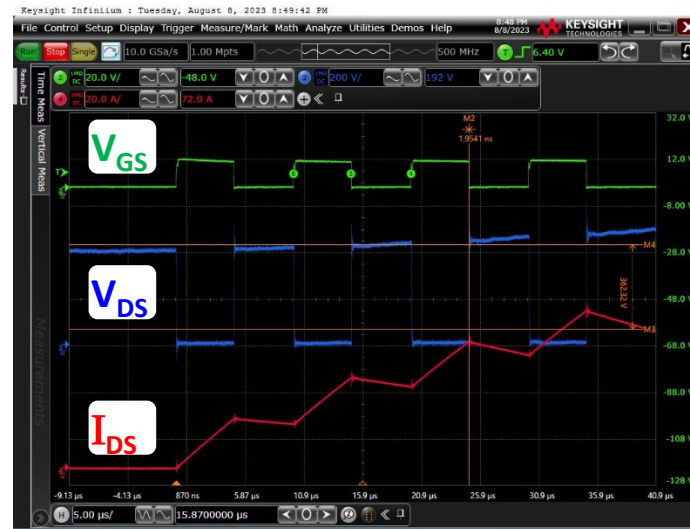


- Double-pulse test:
400 V, 30 A, $R_{\text{SERIES}} = 11 \text{ m}\Omega$



Discrete GaN
42 m Ω max

Significant spikes
Excessive turn-ON ringing
250 V undershoot

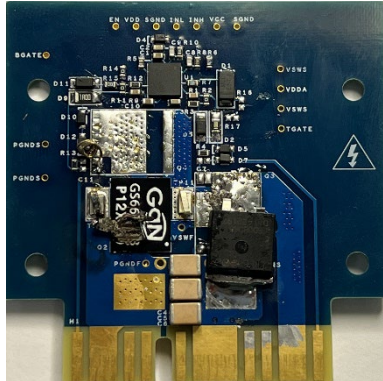
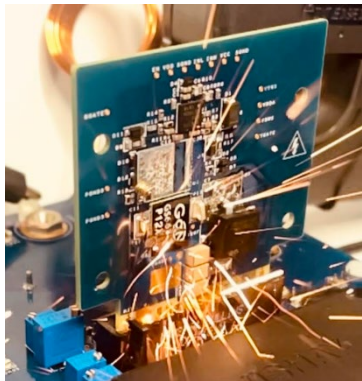
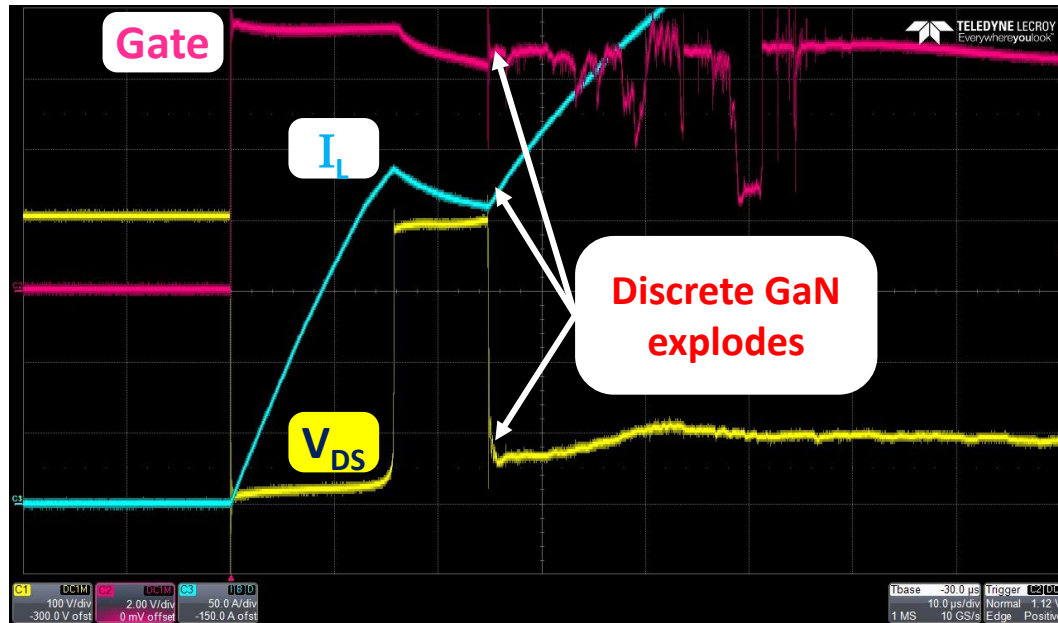


GaNSafe™

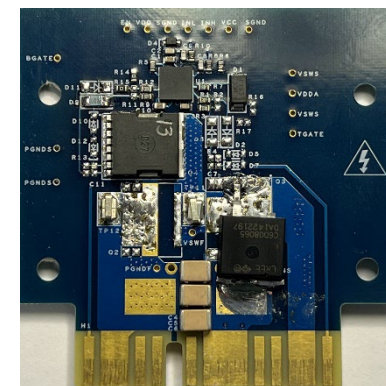
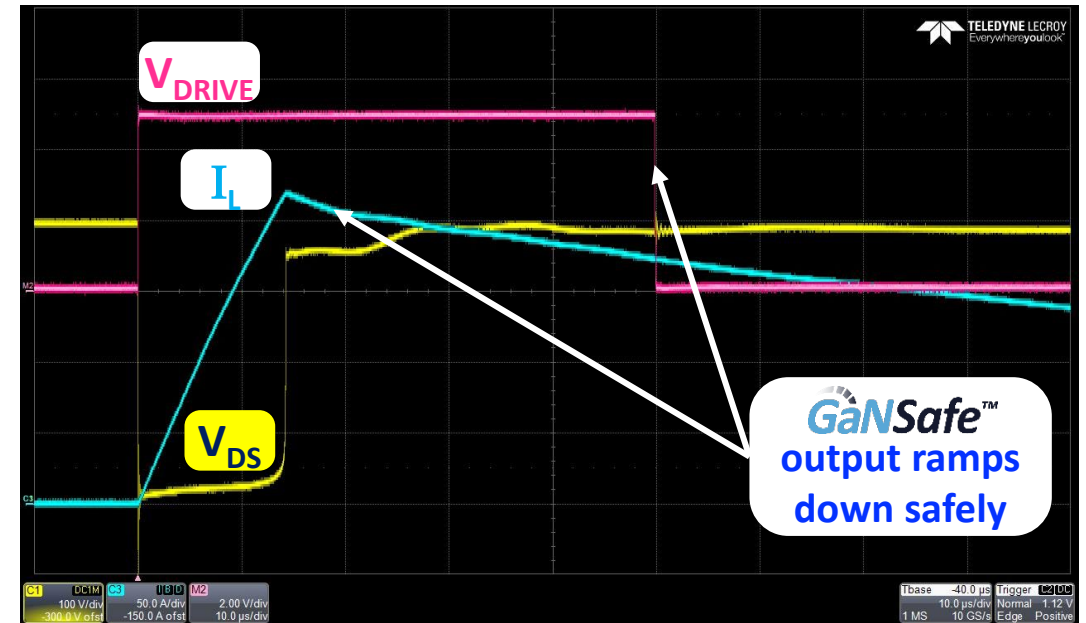
45 m Ω max
(NV6513)

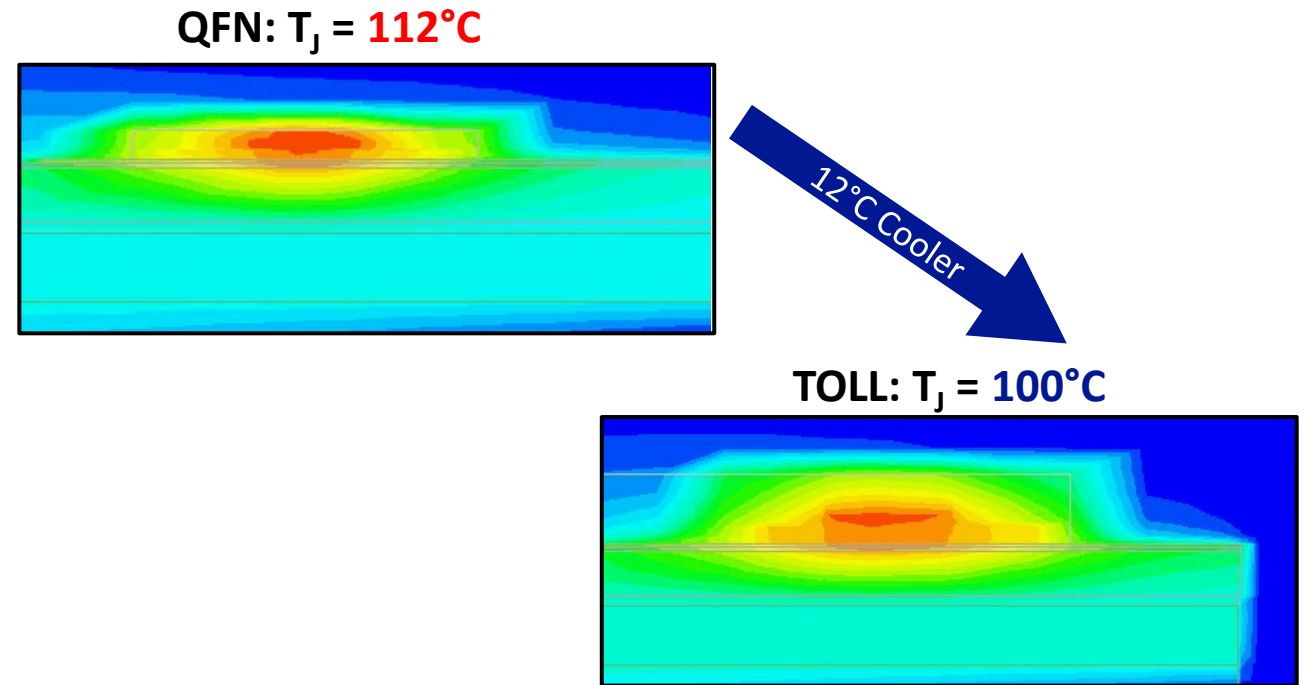
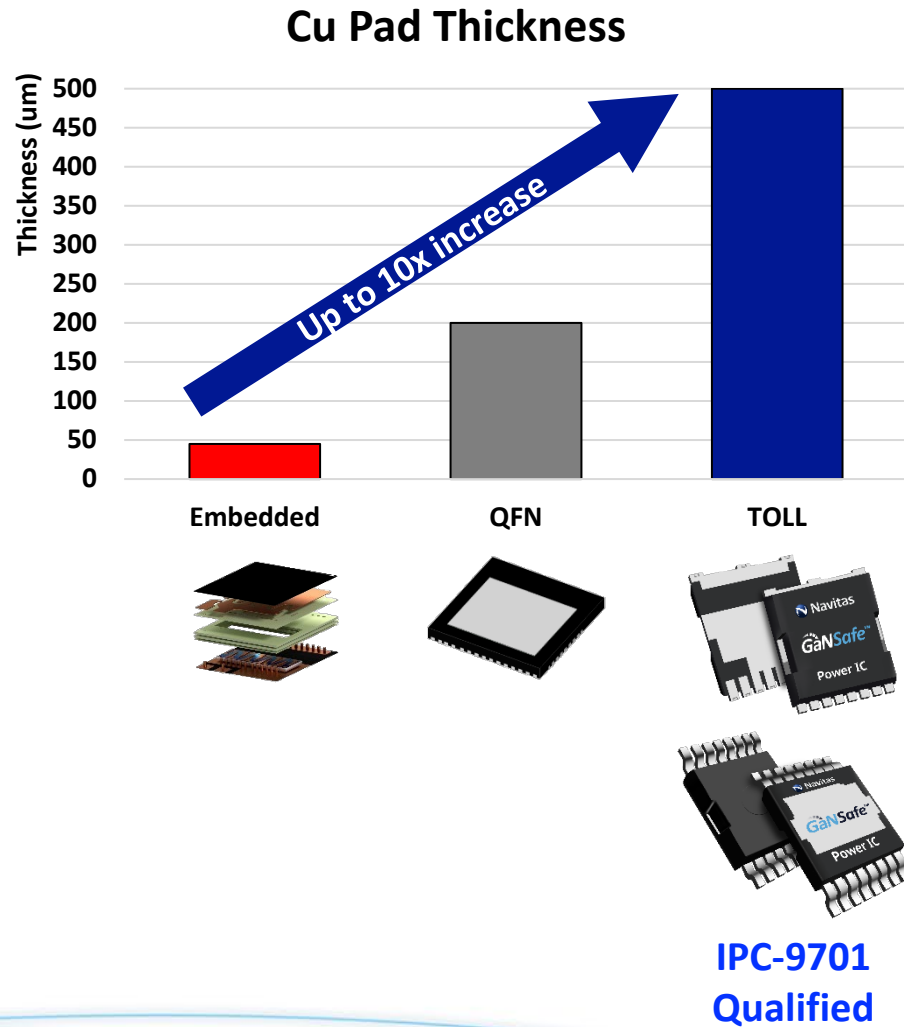
No voltage spikes
No ringing
No undershoot

Discrete GaN under Short Circuit:



GaNSafe™ under Short Circuit:



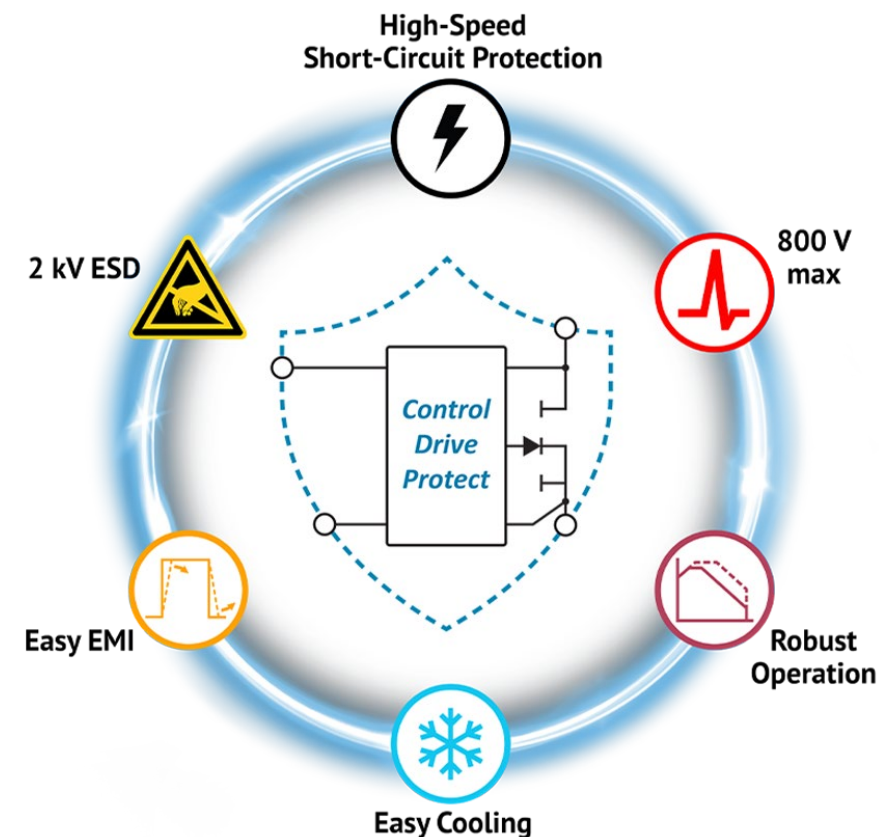


GaNSafe™

- Optimized, system-level cooling ($R_{\theta_{J-A}}$)
 - Larger, thicker Cu pad
 - High-conductivity die attach

		TOLL-4L Bottom-cooled		TOLT-16L Top-cooled	
Max $R_{DS(on)}$ 25 °C, $I_{DS_CONTINUOUS}$	98mΩ 22A	 NV6511 JEDEC 150C Qualified In Mass Production (not targeted for AEC)		 NV6522/Q JEDEC 150C Qualified In Mass Production AEC-Q101 target Q4 '24	
	55mΩ 34A	 NV6512C/Q JEDEC 150C Qualified In Mass Production AEC-Q101 target Q4 '24		 NV6523/Q JEDEC 150C Qualified In Mass Production AEC-Q101 target Q4 '24	
	45mΩ 48A	 NV6513/Q JEDEC 150C Qualified In Mass Production AEC-Q101 target Q4 '24		 NV6524/Q JEDEC 150C Qualified In Mass Production AEC-Q101 target Q4 '24	
	35mΩ 57A	 NV6515/Q JEDEC 150C Qualified In Mass Production AEC-Q101 target Q4 '24		 NV6525/Q JEDEC 150C Qualified In Mass Production AEC-Q101 target Q4 '24	
	25mΩ 80A	 NV6514C/Q JEDEC 150C Qualified In Mass Production AEC-Q101 target Q4 '24		 NV6526/Q JEDEC 150C Qualified In Mass Production AEC-Q101 target Q4 '24	

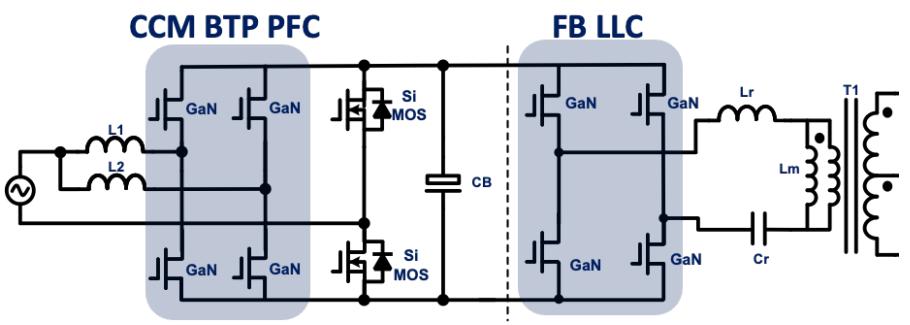
GaNSafe™



GaNSafe™: System Level Thermal Performance

Higher Power Density at lower system BOM:

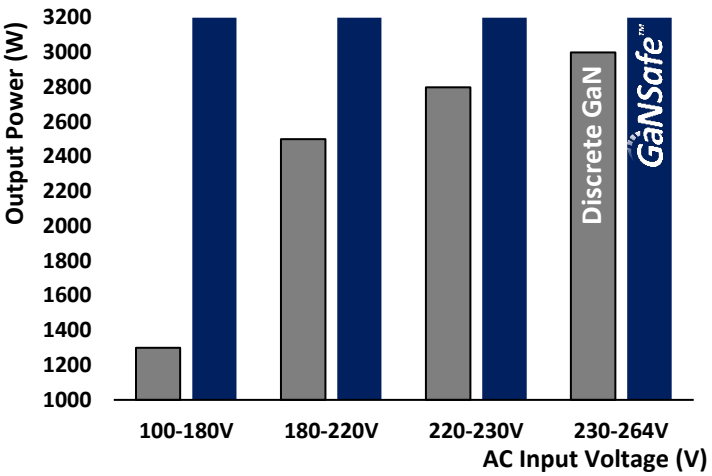
- 94W/in³ CRPS requires **12x Pcs 32mΩ GaNpx™**
- 100W/in³ CRPS: **4x Pcs 45mΩ + 4x Pcs 55mΩ TOLL**



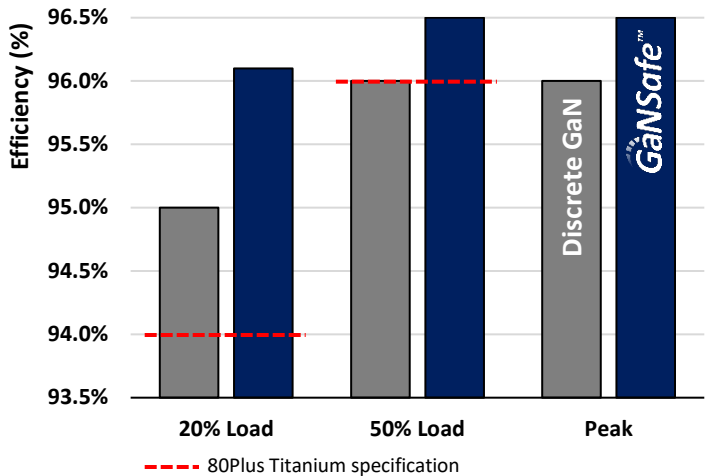
Power	2.8 kW	3.2 kW
PFC	8 x 32 mΩ	4 x 45 mΩ
DC-DC	4 x 32 mΩ	4 x 55 mΩ
Total	12x GaNpx™ 	8x GaNSafe™ 

GaNSafe™
33% fewer
Switches

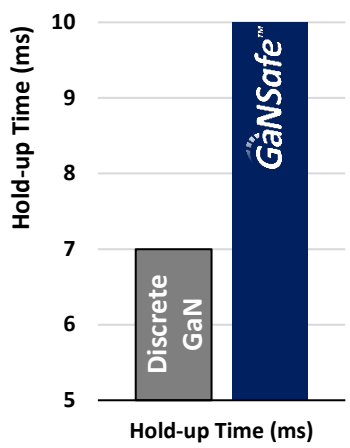
GaNSafe™ True 3.2kW CRPS185



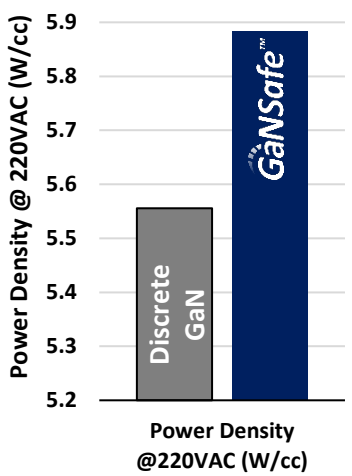
GaNSafe™ Titanium Plus, with margin

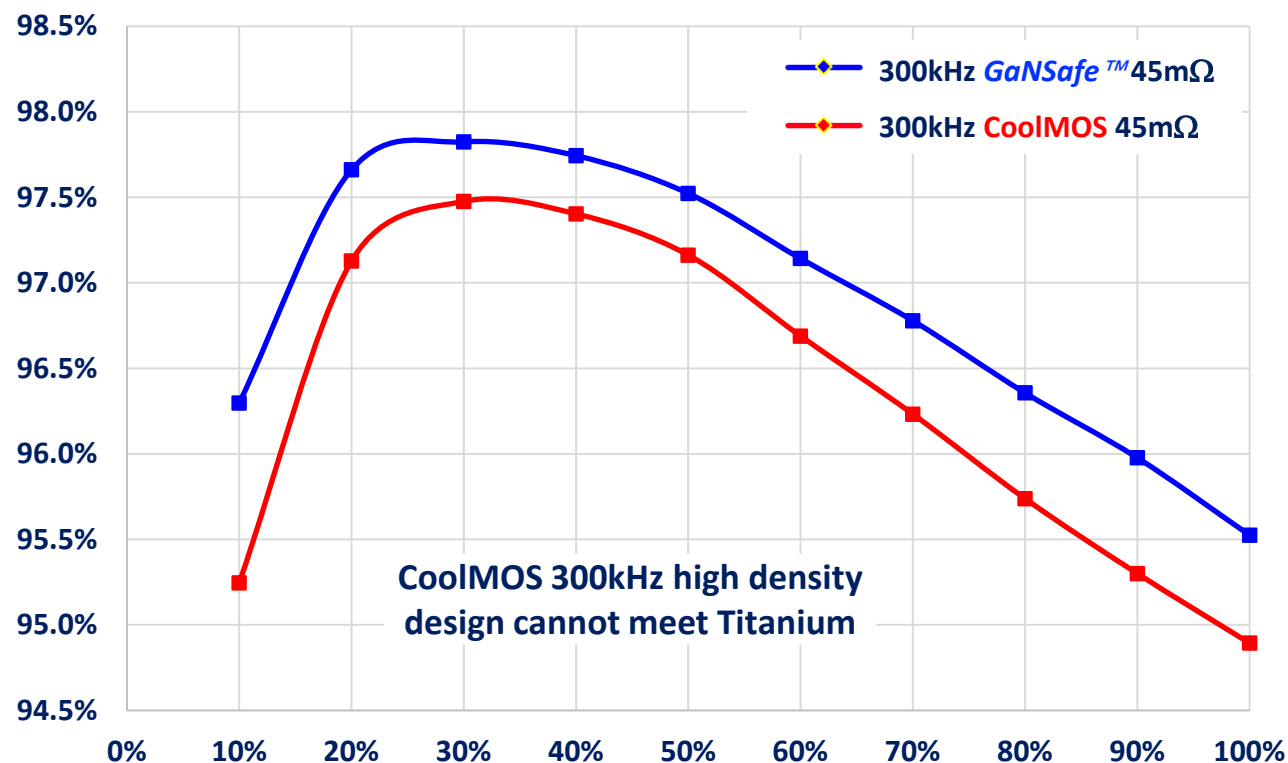
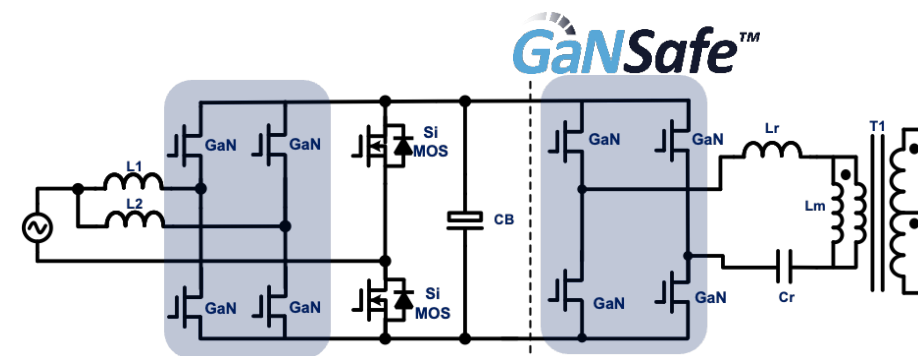
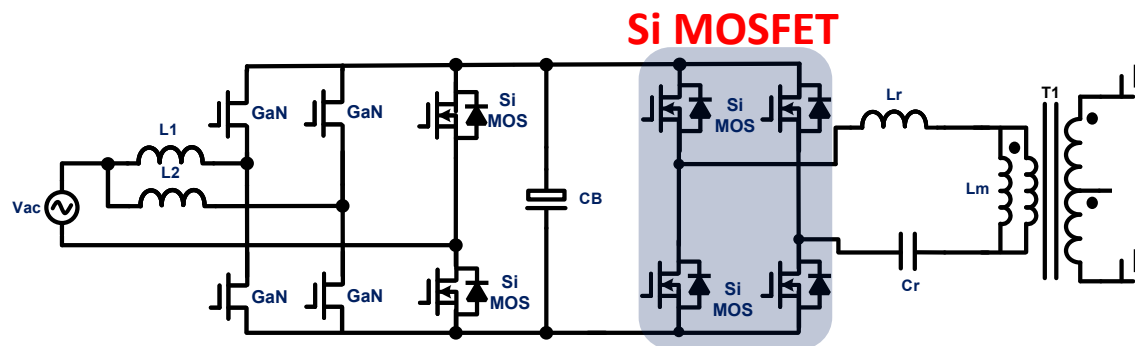


GaNSafe™ +40% Hold-up



GaNSafe™ ~100W/in³



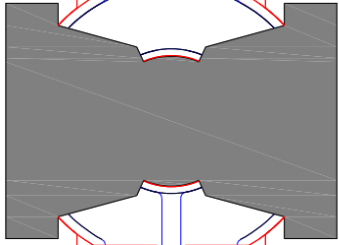
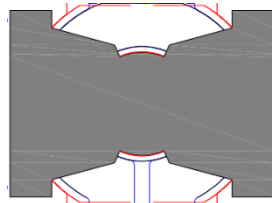
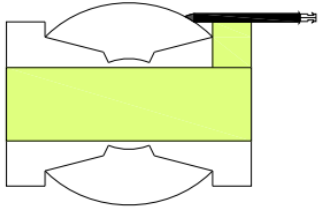
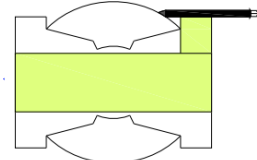


- **GaNSafe™** meets Titanium with higher power density at 300kHz
- **CoolMOS** does not meet Titanium at 300kHz F_{SW} in LLC stage
- **GaNSafe™** meets EN55022 / CISPR22 Class A (CE and RE)

Si 150 kHz LLC

GaNSafe™

300 kHz LLC

Main Transformer	 PQ3628 Size: 36 x 28 x 24 mm	➔	 PQ3033 = 14% smaller Size: 30 x 33 x 21 mm
Resonant Choke	 PQ2618: Size: 26 x 18 x 19 mm	➔	 PQ2018 = 43% smaller Size: 20 x 18 x 14 mm
Resonant Capacitor & Output MLCC	 630 V, 10 nF 1206 *40pcs 16 V, 10 uF 1206 *64pcs	➔	 630 V, 10 nF 1206 *12pcs 16 V, 10 uF 1206 *50pcs = 40% fewer
Primary Switch	 IPT60R055CFD7 *4pcs	➔	 NV6512C *4pcs
Protections & Features	 1 kV ESD	➔	 SCP, 2 kV ESD, dV/dt Control

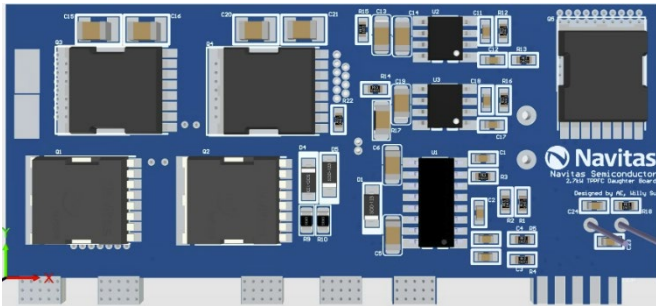
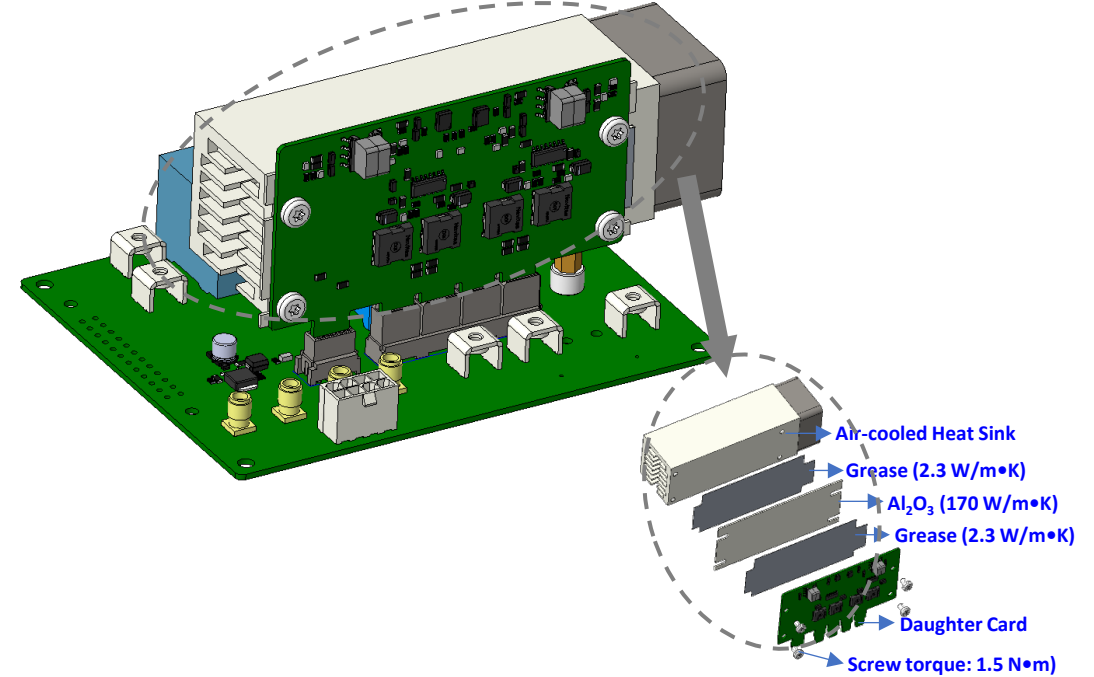
GaNSafe™ : Eval Kits & Custom Daughter Cards

Eval Kit Description

- Eval Kits for NV65xy product lines (**GaNSafe™** TOLL and TOLT)
- Configurable topology for Double Pulse, Buck/Boost, CCM BTP PFC
- Heat Sink & Full-Bridge daughter card allows bench testing at 2kW+

Eval Kit Ordering

- **Sales:** \$200 per Eval Kit (complete Power Board, Daughter Card, Heat Sink assembly)
- **Part Numbers:** NVE070A+NVE071A (NV6515 TOLL) *or* NVE071A+NVE083A (NV6525 TOLT)
- NVE071A Power Board supports either TOLL or TOLT Daughter Cards
- Distribution to qualified Beta Customers approved by NVTS Marketing
- User Guide and all technical collateral provided with each Eval Kit



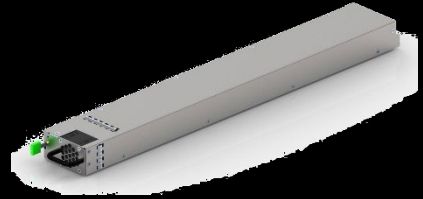
Daughter Cards

- Open-loop half-bridge **GaNSafe™** power stage with I/O and Connector configured to End-Customer specification
- Connects to customer's mainboard for easy evaluation

Availability

- Qualified customers designing Mainboard / Daughter Card power stage architecture with bottom-cooling

Accelerating High Performance Data Center



12kW ORV3 PSU
54V_{OUT} 98% Efficiency



8.5kW ORV3 PSU
54V_{OUT} 98% Efficiency

CRPS185 4.5kW 54V_{OUT}
97% Efficiency, 138 W/in³

CRPS185 3.2kW 12V_{OUT}
Titanium+ 98 W/in³

Digital CrM BTP PFC with
Modular LLC design

CRPS185 2.7kW 12V_{OUT}
Titanium+ 83 W/in³

CRPS185 2.0kW 12V_{OUT}
Titanium+ 62 W/in³

CRPS185 1.6kW 12V_{OUT}
Titanium+ 50 W/in³

All GaNSafe

Hybrid SiC/GaN

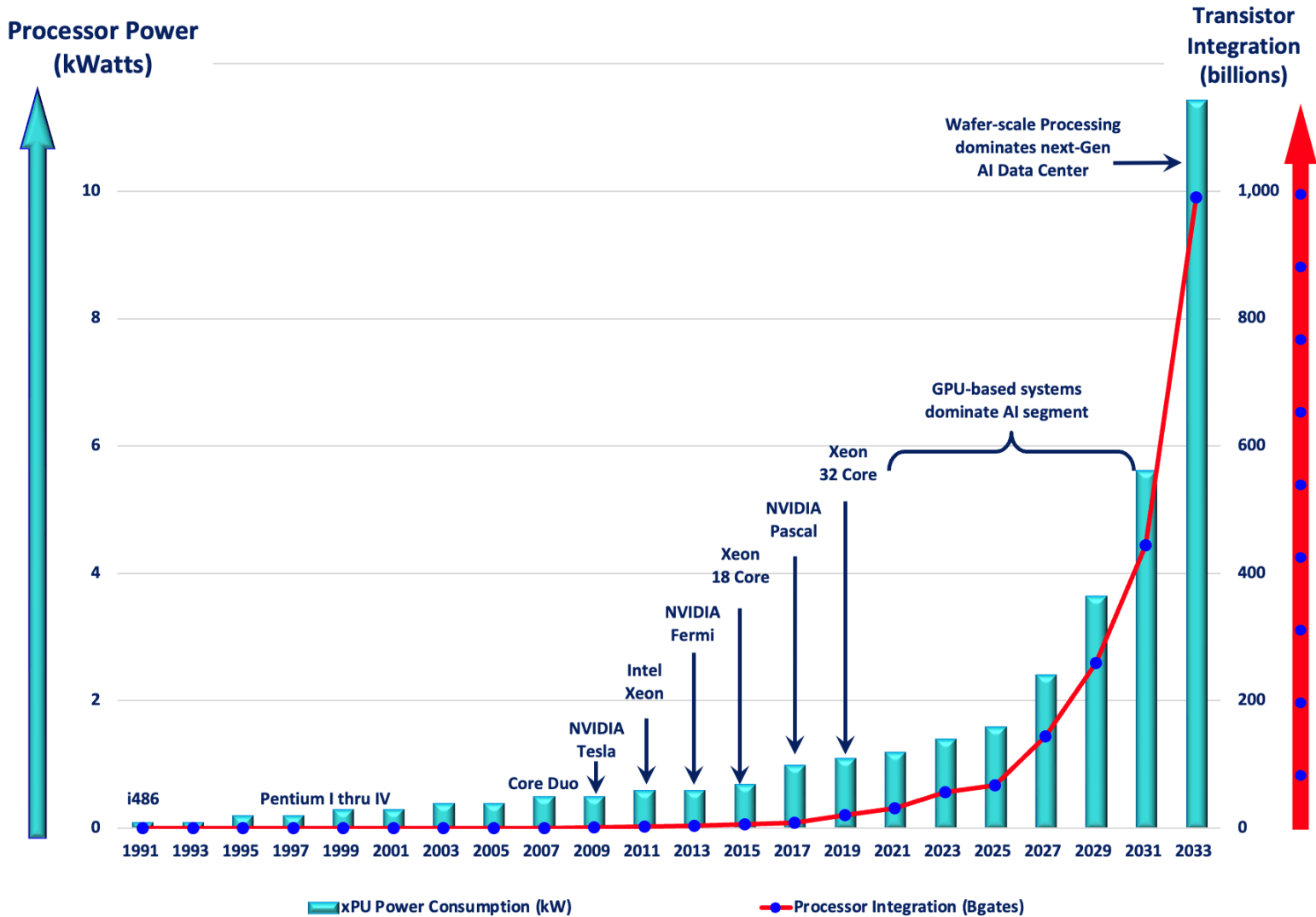
PFC SiC or GaN

2022

2023

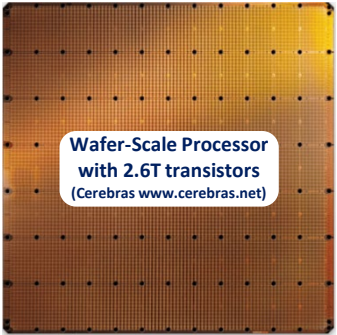
2024

2025



Power consumption cliff with AI:

- Processors surpass 2.6 trillion transistors
- Board-level power will exceed 10kW+
- CRPS power density will reach 200W/in³
- GaNSafe™** and **GeneSiC™** essential



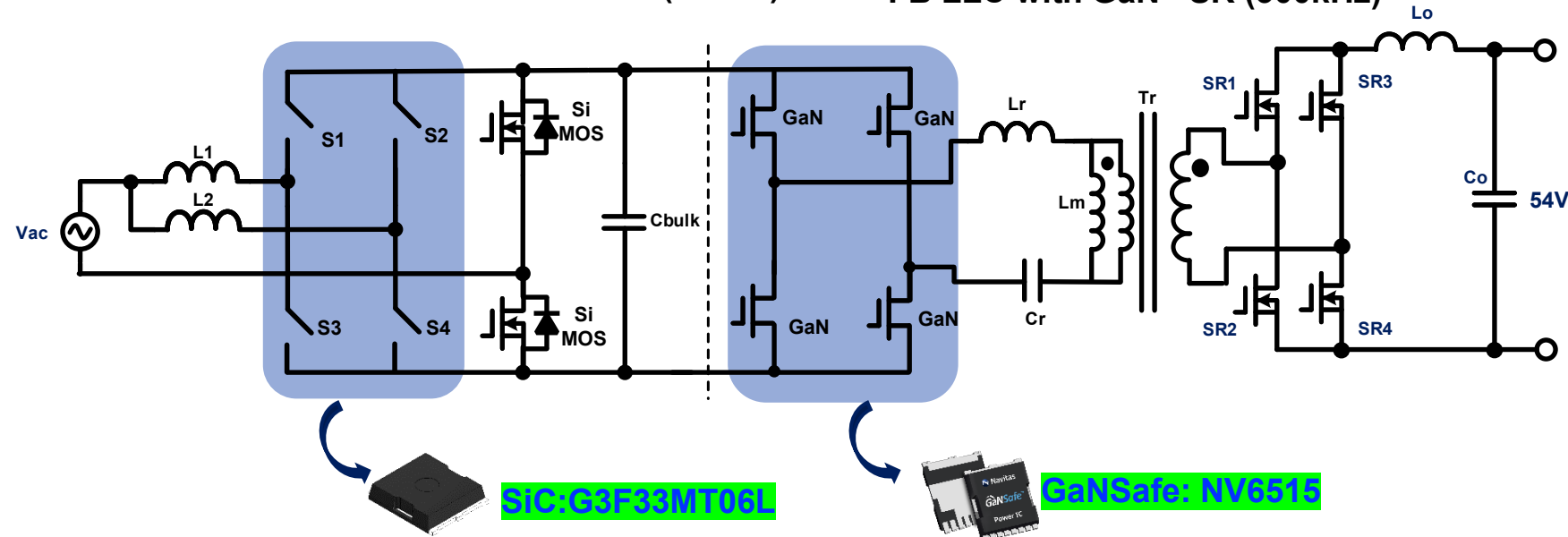
NVTS CRPS185 4500W 54V



Released

Interleaved CCM TP PFC with SiC/GaN(80kHz)

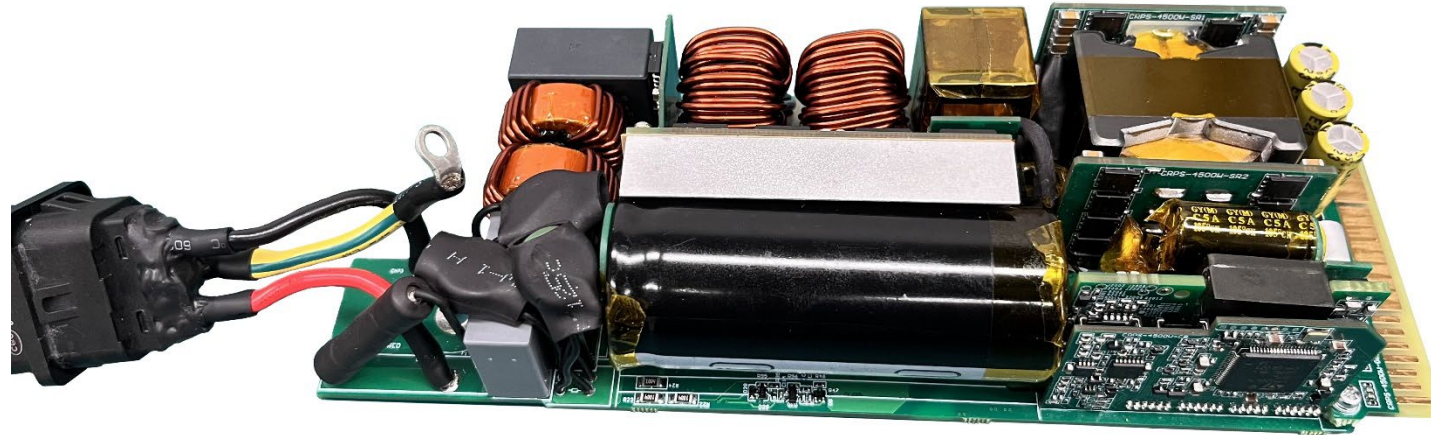
FB LLC with GaN +SR (300kHz)



NVTS CRPS 4500W Platform Features

- Supports AI Data Center GPU Server
- Highest Power Density 138Watts/inch³
- Titanium+ Efficiency >97% @ 50% load
- Hold-Up Time meets 10ms @ 4.2kW

Samples available now





Combination 6.6 kW OBC + 3 kW DC-DC:

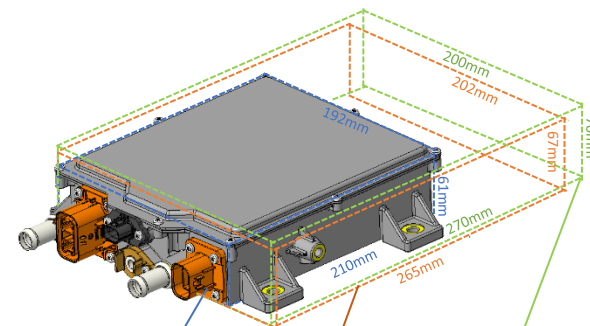
- **OBC AC Input:** 90~265 V_{AC} up to 32 A
- **OBC Battery Output:** 470~860 V_{DC}, full load
- **OBC Power:** 6.6 kW charging, 6.0 kVA discharging
- **HV-LV DC-DC Output:** 9~16 V_{DC}
- **Topology:** 1-Φ CCM BTP PFC (100kHz) + Bi-Directional CLLC (500kHz ~ 1.2MHz) + HV-LV DC-DC (65kHz)

Mechanical:

- **Dimensions:** 210 x 192 x 61mm (≤ 2.5 litre)
- **Cooling:** -40 to +65°C (Cold Plate)
- **Communication:** IP 67, CAN Bus interface

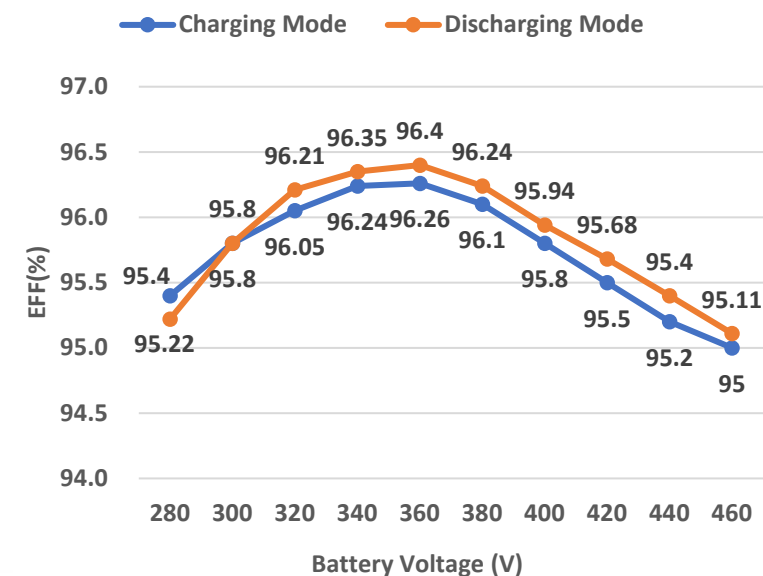
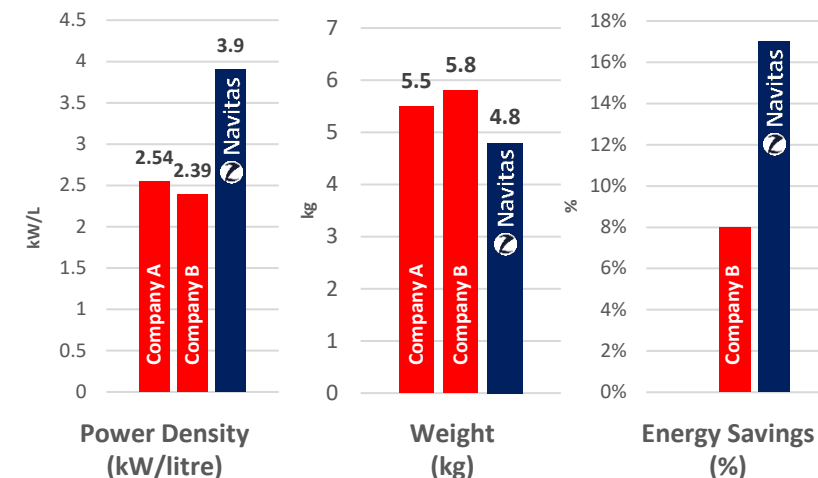
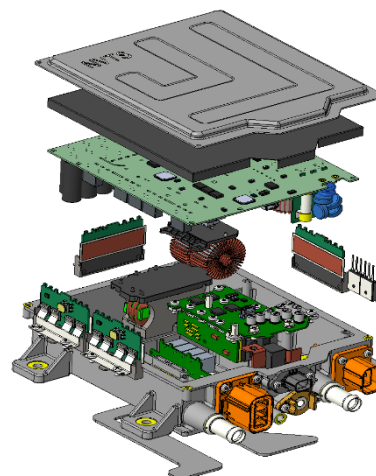


Achieves Ultra High Power Density 3.9 kW/litre



Silicon Competitor B

Silicon Competitor A

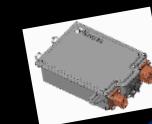


Accelerating EV Power Train High Density

- Hybrid design with SiC (CCM BTP PFC) and GaN (CLLC) for robustness, lower size/weight (ultra-high power density)
- Optimized package and system thermal design
- Improved topologies

Power density

Hybrid
SiC & GaN
<1.9L



6.0kW/L

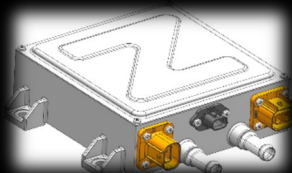
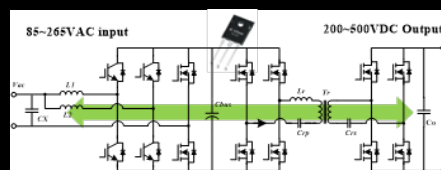
5.0kW/L

3.9kW/L

2.5kW/L

1.8kW/L

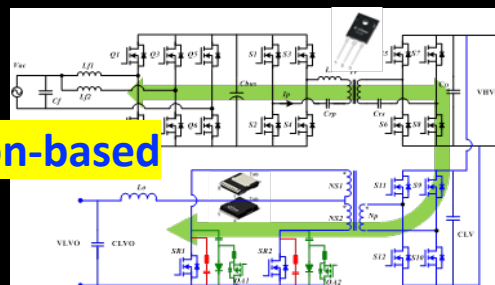
1.0kW/L



Bi-D 6.6kW OBC

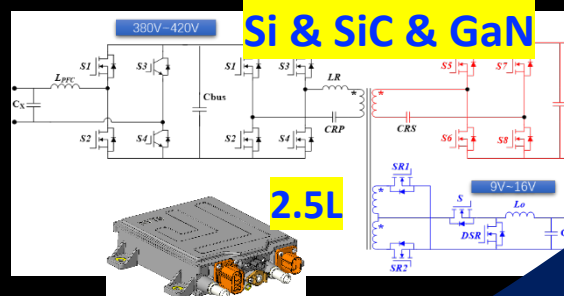
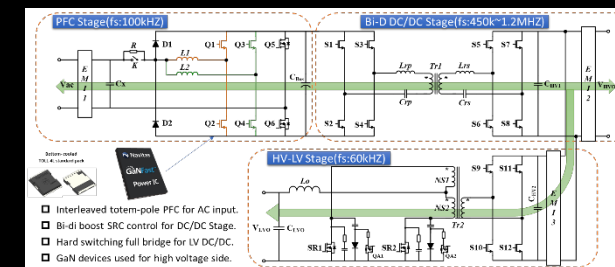
Gen1 (Y2015)

Silicon-based



3.8L

Gen2 (Y2019)



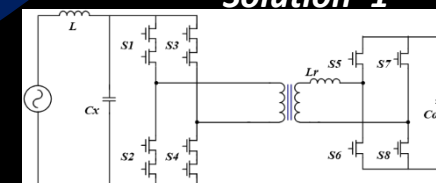
Bi-D 6.6kW OBC+3kW LVDC

Gen3 (Y2022)

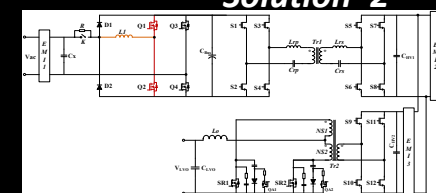
Si & SiC & GaN

2.5L

Solution 1



Solution 2



Gen4 (Y2025)

Bi-D 6.6kW OBC+3kW LVDC

Discover more at
navitassemi.com

