tech Taipei
for top electronics engineers

Navitas Delivers AI Server Power: GaN & SiC Hybrid 4.5 kW

Kevin Wang
Sr Director Sales and Taiwan Country Manager

21st March 2024

10 YEARS

2014

Navitas Founded

2016

World's First GaN Power IC Prototype

"Breaking Speed Limits with GaN Power ICs" APEC Keynote

2018

Mass Production of GaNFast Chips

2019

Best Practices Award

2021

VDD Tech Acquisition Digital Isolators

$1B+ IPO

World's First 20-Year Warranty

2022

World's First Autonomous GaN Power IC

World's First GaN Sustainability Report

World's First 100,000 tons CO_2 Saved

GeneSiC Acquisition Leading-Edge SiC

Fastest 75 Revenue Growth

World's First Semi Company

2023

World's First 100,000,000 GaN Shipments

Elevation Acquisition High-speed Silicon Controllers

Fastest 75 Revenue Growth

World's Most Protected GaN Power

Top 50 Most Successful Small Company

HQ Opening Torrance, CA

2024

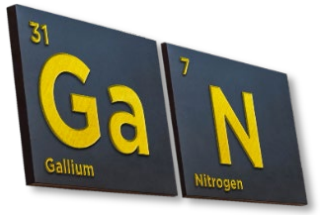
10 YEARS

Pure-Play, Next-Gen Power Semiconductors

Navitas

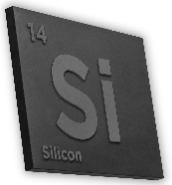
Navitas

GaNFast™



GeneSiC™

Up to 20x	Up to 3x	Up to 40%	Up to 3x	Up to 3x	Up to 25%
Faster Switching(1)	Smaller & Lighter(1)	Energy Savings(1)	Higher Power Density(1)	Faster Charging(1)	Lower System Cost(2)

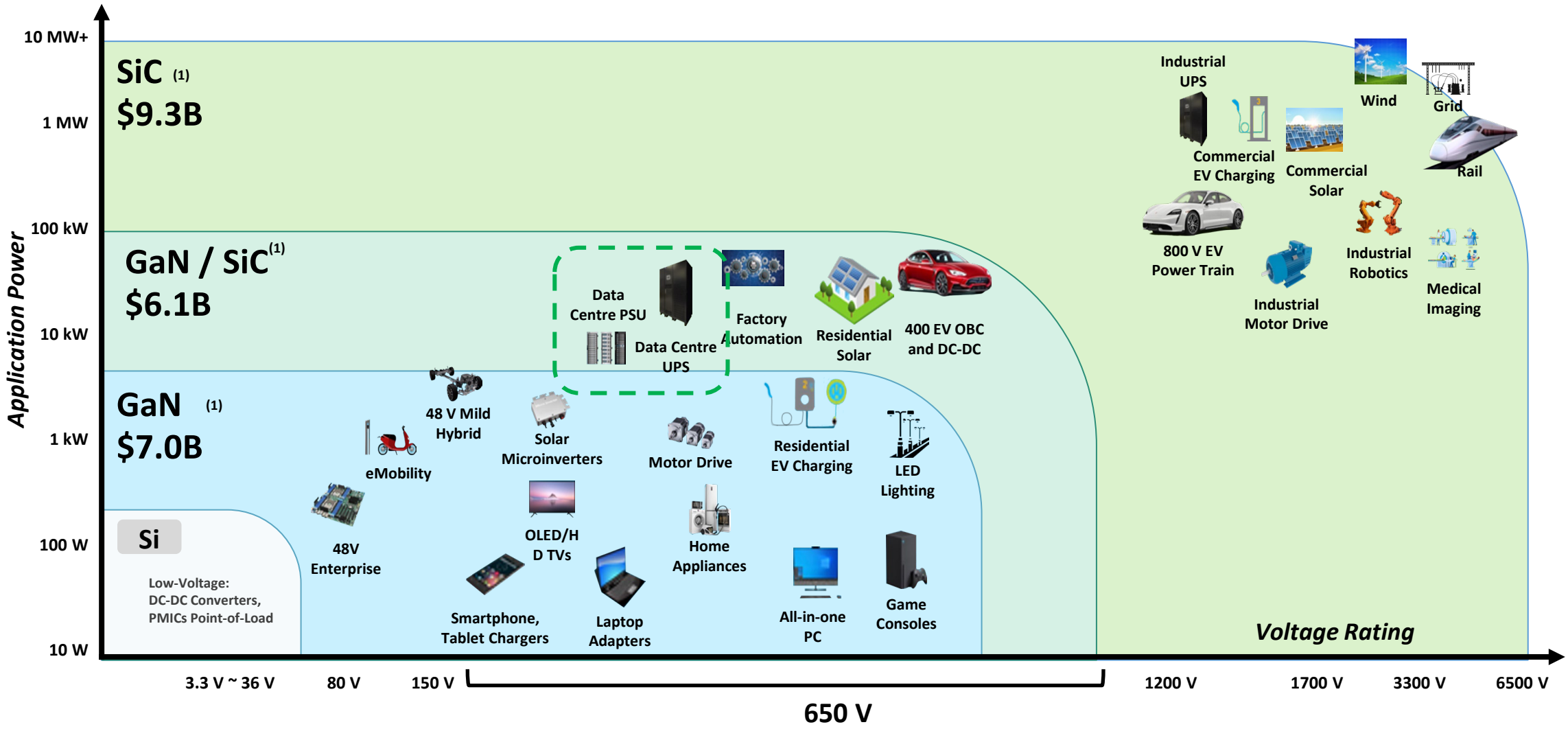


GaN and SiC replacing Si in next-generation power applications

1. Statistical data is based on Navitas estimates of GaN-based systems compared to Si-based estimates in the 2024-2025 timeframe. Based on Navitas measurements of select GaN-based mobile wall chargers compared to Si-based chargers with similar output power, incl. 2019 study of 65W fast chargers, 2022 customer statement re 2.7 kW data center AC-DC
2. Navitas estimates based on customer feedback as the expected system cost saving overtime as of April 2023

$22B+ GaN & SiC 'Pure-Play' Opportunity[1]

Navitas



Notes: Axes not to scale

1. Based on internal company estimates, Navitas believes that the potential market opportunity in 2026 is $22B+ for GaN and SiC, replacing certain of the silicon market share
2. Per Yole Developpment, 2024-2024 estimated market revenue

The Efficiency Challenge: “Titanium Plus”

Navitas

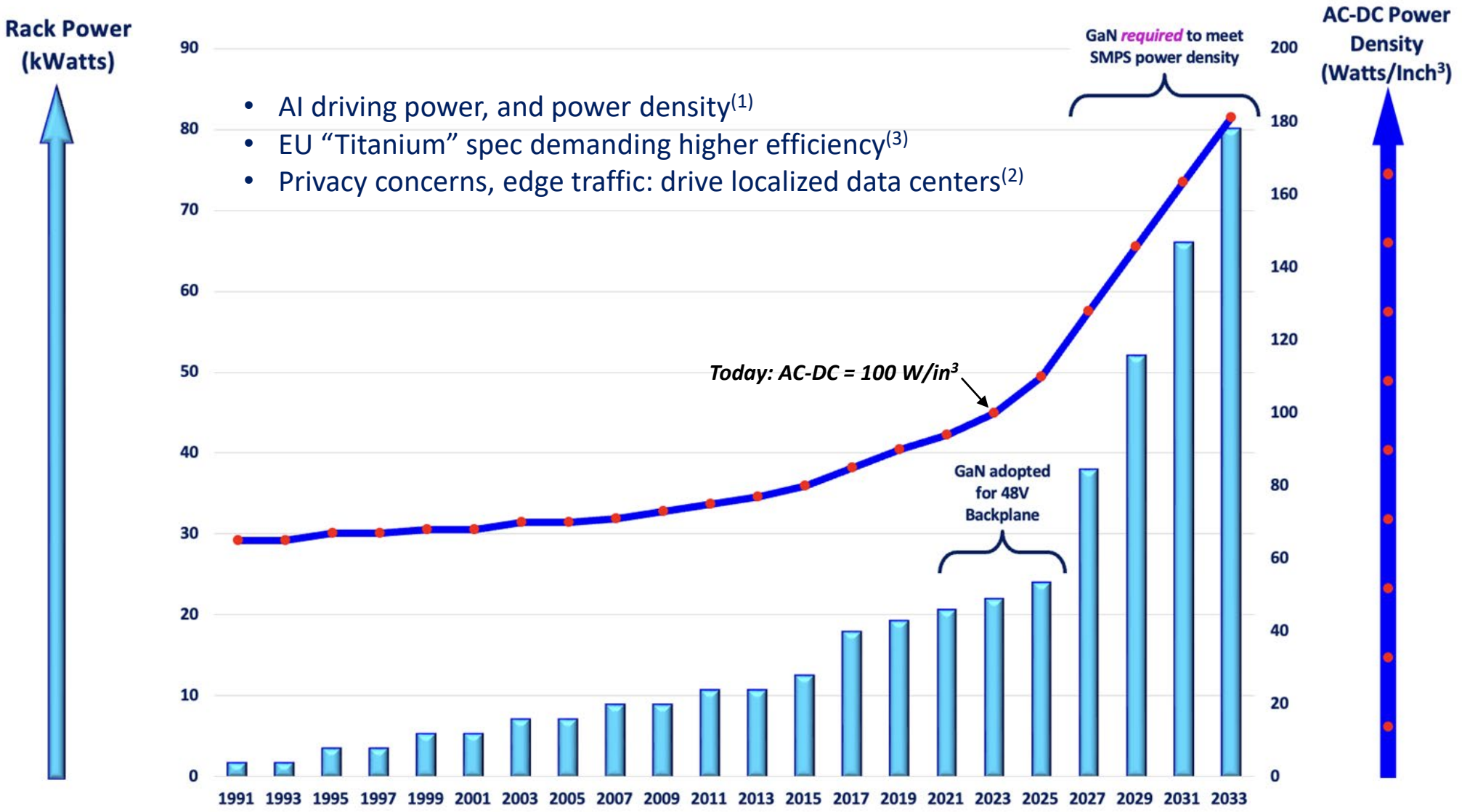
80 Plus test type	Icon	115 V internal non-redundant				230 V internal redundant				230 V EU internal non-redundant			
Percentage of rated load		10%	20%	50%	100%	10%	20%	50%	100%	10%	20%	50%	100%
80 Plus Gold	80 PLUS GOLD		87%	90%	87%		88%	92%	88%		90%	92%	89%
80 Plus Platinum	80 PLUS PLATINUM		90%	92%	89%		90%	94%	91%		92%	94%	90%
80 Plus Titanium	80 PLUS TITANIUM	90%	92%	94%	90%	90%	94%	96%	91%	90%	94%	96%	94%

European Union: ‘Directive 2009/125/EC, 2019 Annex’

The Power Challenge #1: Data Center Power

Navitas

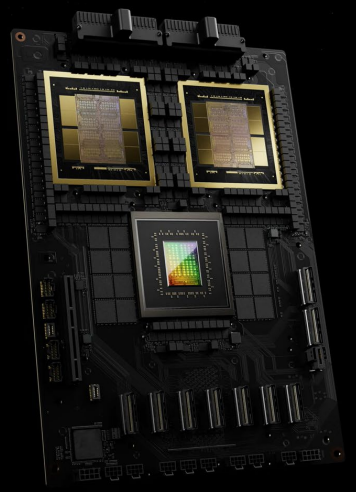
- AI driving power, and power density(1)
- EU "Titanium" spec demanding higher efficiency(3)
- Privacy concerns, edge traffic: drive localized data centers(2)

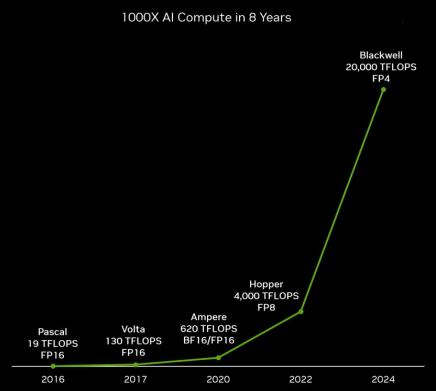


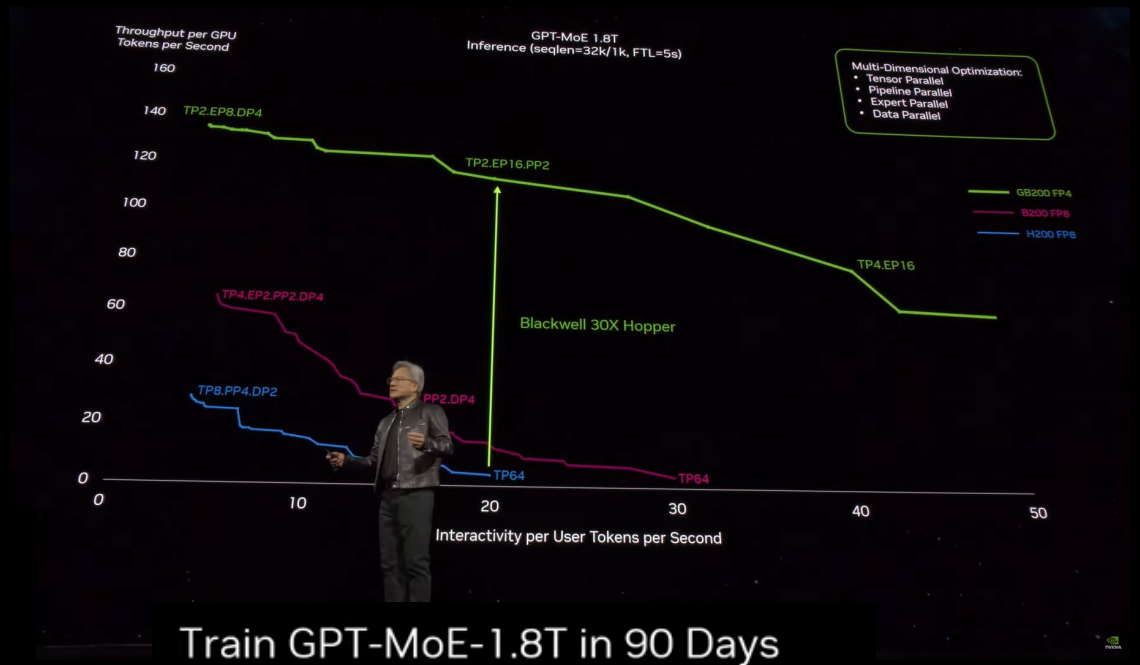
1. Cerebras white paper / website
2. TD Cowen, per "AI to drive data center investments", LightReading.com, 4-26-23
3. European Union 'Directive 2009/125/EC, 2019 Annex', power supplies must be >96% efficiency peak, as of 1-1-23

The Power Challenge #2: NVIDIA AI GPUs

Navitas







Train GPT-MoE-1.8T in 90 Days

Blackwell GB200 NVL72
2000 GPUs | 4MW

Blackwell processes 30x more tokens/s and only ¼ the power of Grace Hopper but still *2,000W per GPU* and

>100kW per rack

Images from NVIDIA GTC2024

The Power Solution: Navitas AI Roadmap

Navitas

GaNSafe™

The World's Safest GaN

High-Speed
Short-Circuit Protection

2 kV ESD

800 V
max

Control
Drive
Protect

Easy EMI

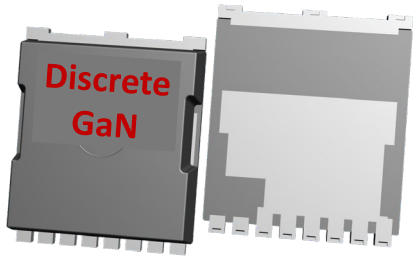
Robust
Operation

Easy Cooling

Navitas

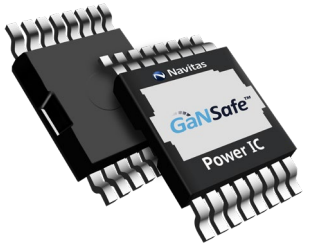
GaNSafe Reliability: Double-Pulse Test

- Double-pulse test:
  400 V, 30 A, R_{SERIES} = 11 mΩ



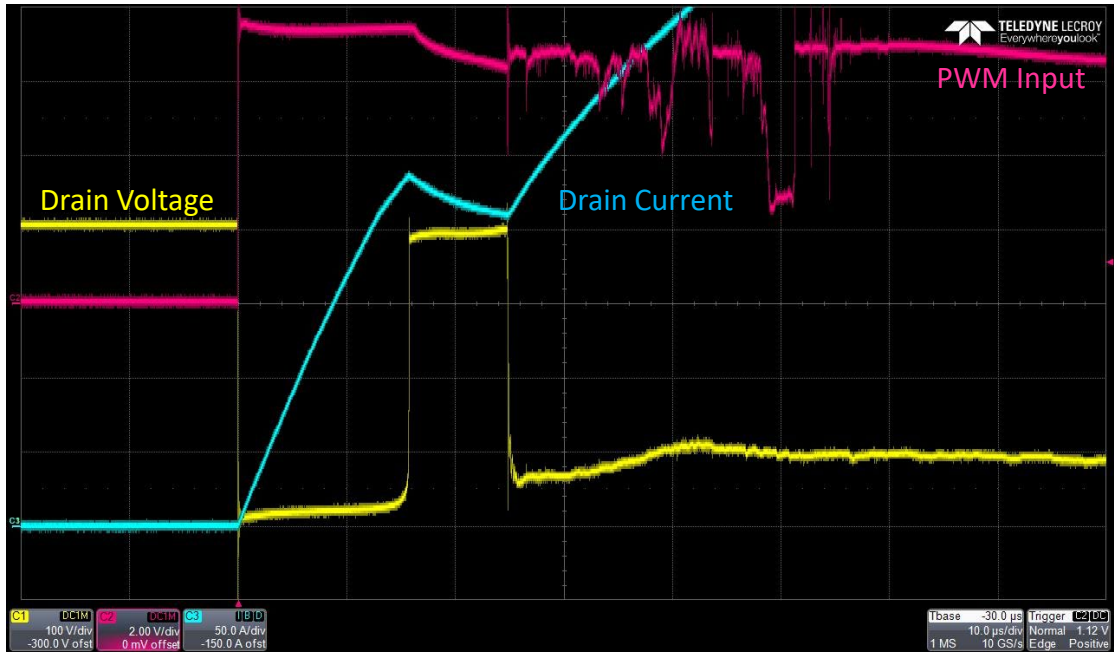
Discrete GaN
42 mΩ max

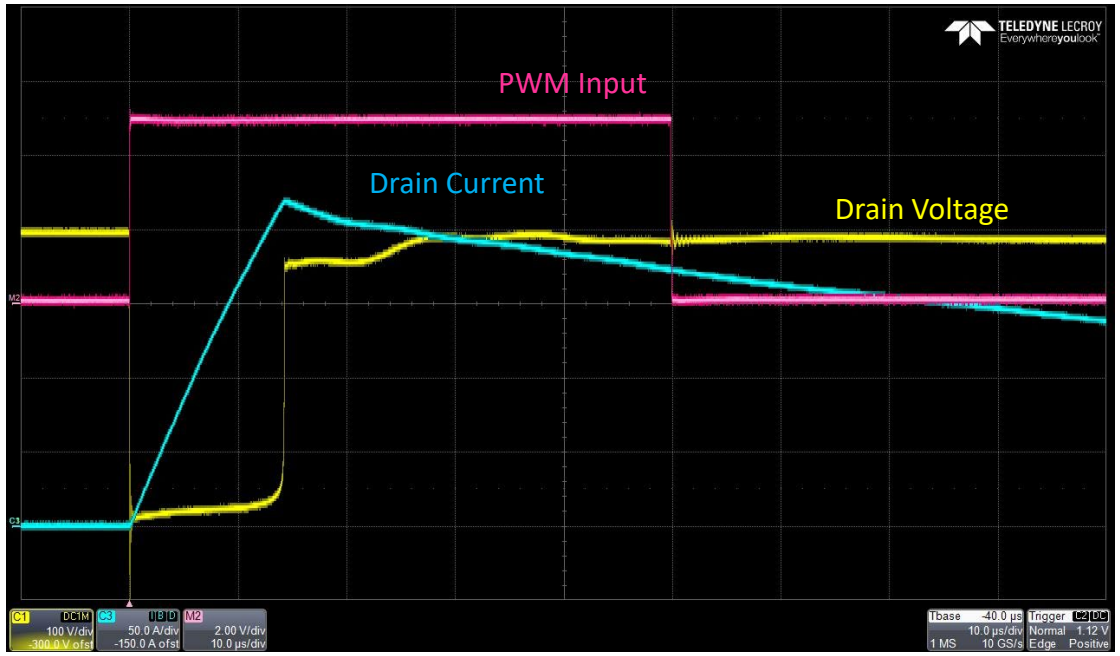
Significant spikes
Excessive turn-ON ringing
250 V undershoot

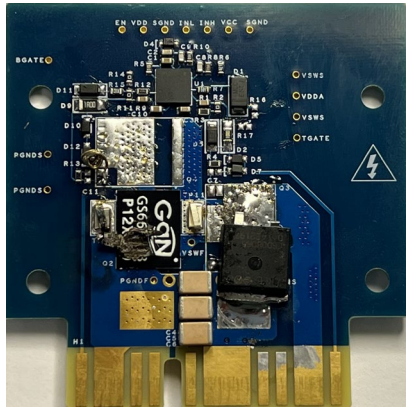


GaNSafe™
45 mΩ max (NV6513)
No voltage spikes
No ringing
No undershoot

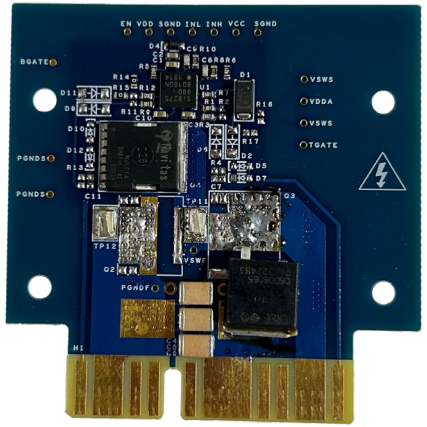
GaN Discrete → GaNSafe







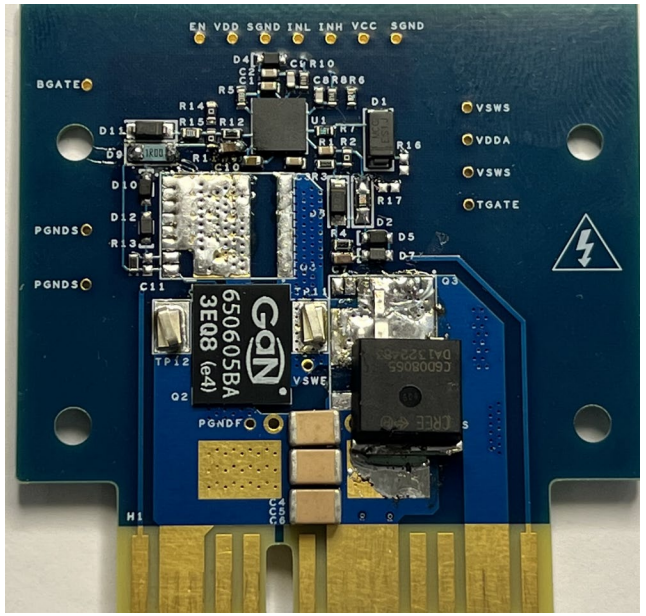
- Company X GaN discrete
- 650 V, 25 mΩ typ
- **Fails *short***

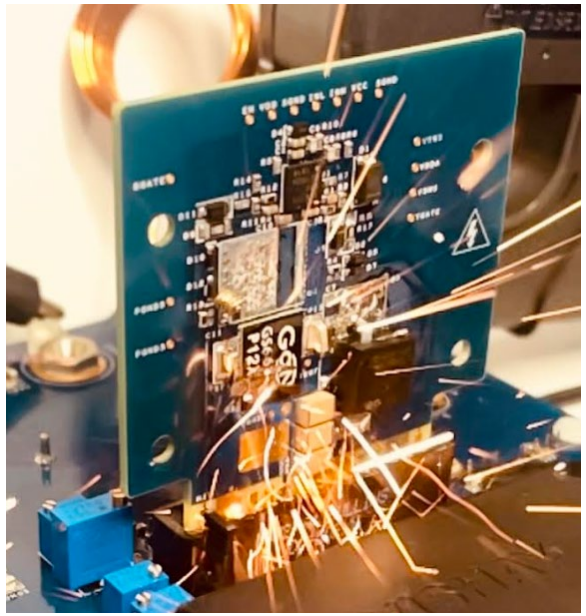


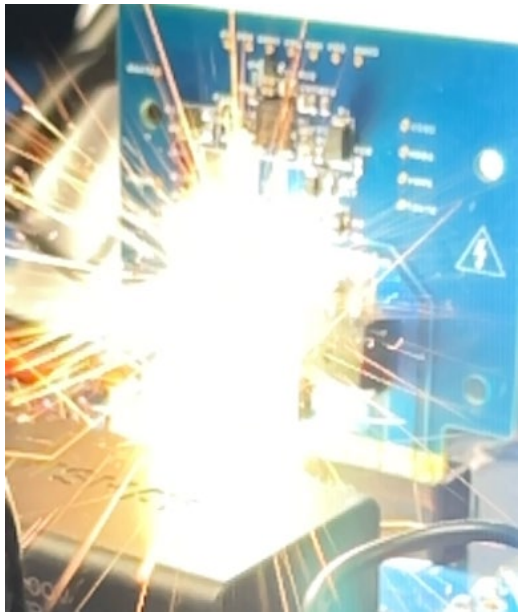
- Navitas GaNSafe
- 650 V, 25 mΩ max (NV6514)
- ***Survives short-circuit***

Discrete GaN: Short-Circuit Failure

- Repeatable issue







GeneSiC™

Patented Trench-Assisted Planar SiC MOSFETs

Navitas

Up to 6.5 kV

Largest range of SiC FETs & diodes
(650 V to 6.5 kV)

Fast Switching

Highest efficiency hard-switch, soft-switch
(Lowest E_{ON}, E_{OFF}, E_{ZVS} losses)

Cool Operation

Lowest $R_{DS(ON)}$ at high temperature
(25% lower than industry typical)

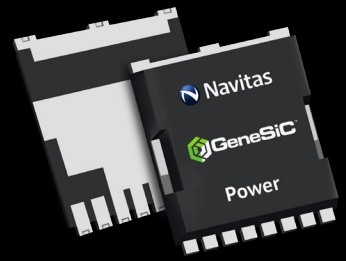
Cool. Fast. Rugged.

100%-Tested Robust Avalanche

Highest published capability to handle excess energy in fault condition

Long Short-Circuit Withstand Time

World-class survival duration in fault condition



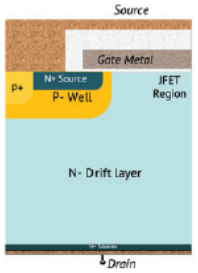
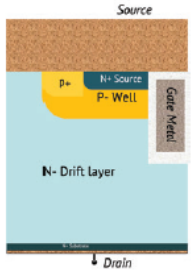
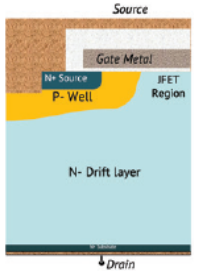
High-Power Paralleling

Matching currents
(Stable V_{TH})

Based on Navitas testing of 1200V SiC MOSFETs vs. competitor products

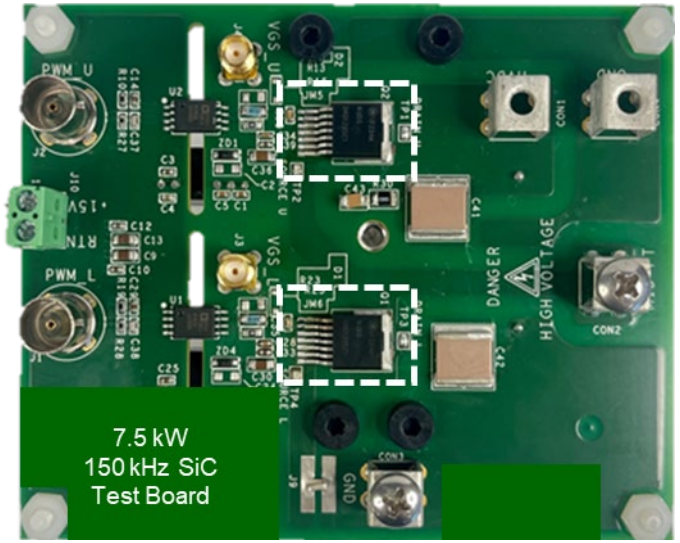
Trench-Assisted Planar Gate – No Compromise

Navitas

	Planar	Trench	GeneSiC
			
Manufacturability	» *Repeatable* » *High yield* » *Low cost*	» *Inconsistent trench etch* » *Lower yields* » *High cost*	» *Repeatable* » *High yield* » *Low cost*
Performance	» *High $R_{DS(ON)}$ / area* » *Slow switching* » *High $R_{DS(ON)}$ / Δ temp*	» *Lower $R_{DS(ON)}$ / area* » *Faster switching* » *High $R_{DS(ON)}$ / Δ temp*	» *Lower $R_{DS(ON)}$ / area* » *Fastest switching* » *Lowest $R_{DS(ON)}$ / Δ temp*
Reliability	» *Rugged gate oxide (stable V_{TH})*	» *Failures due to non-uniform gate oxide* » *Lower short-circuit capability*	» *Highest 100% tested avalanche* » *Long short-circuit withstand time* » *Rugged gate oxide (stable V_{TH})*

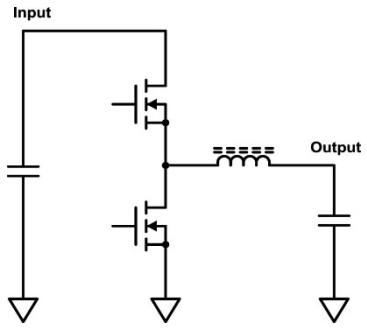
Faster, Cooler, Longer Lifetime

Navitas

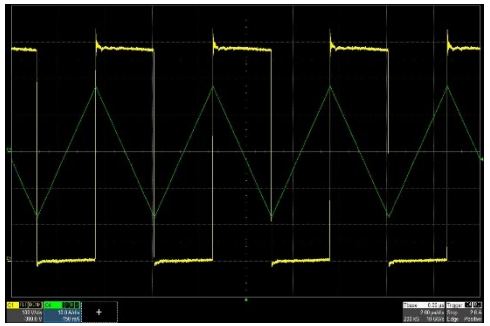


Test Board

- GeneSiC trench-assisted planar FET vs. Competitor SiC FET
  - 1,200 V, 40 mΩ, D2pak in half-bridge
  - Represents 7.5 kW DC-DC converter (e.g. data center, EV)
  - 150 kHz switching = ~10x faster than Si IGBT example
- **>80% energy savings (>3,000 kWh/yr) *vs* *Si IGBTs***
  -25°C cooler = 3x longer life *vs other SiC*
  (reduced maintenance / repair costs)



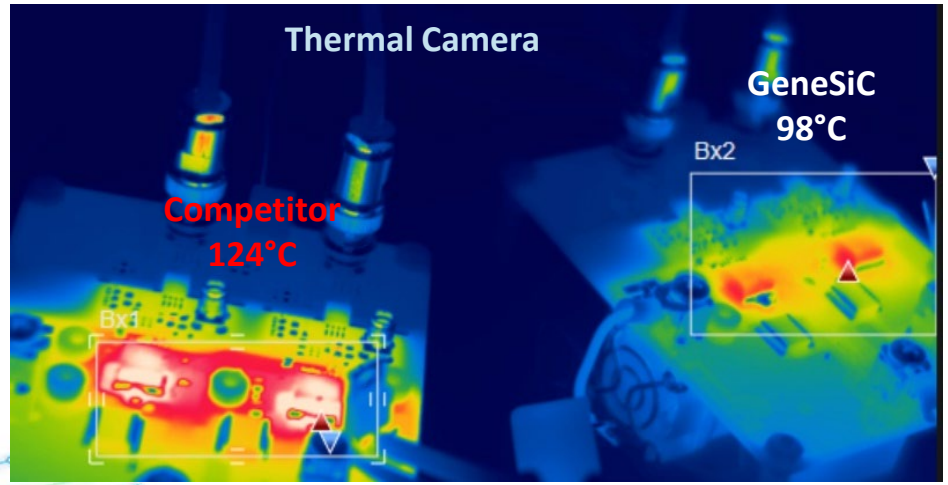
Test Circuit
(1-phase of 3-phase motor drive)



Switching Waveforms
(40 A pk-pk, 20 A turn-off}

Competitor SiC
45 W system loss

GeneSiC
40 W *system* loss
-30% *SiC* loss

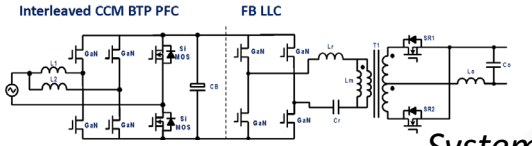


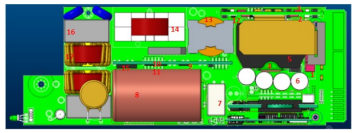
Faster Time-to-Market: Unique System Design Centers

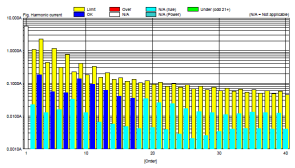
Navitas

Power System *Platform* Design

High Frequency, High Efficiency, High Density, High Integration

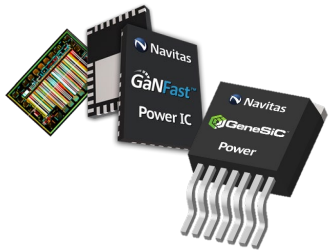






System design evaluation & feedback

Electrical, thermal, mechanical, EMI, BOM cost, manufacturing and yields

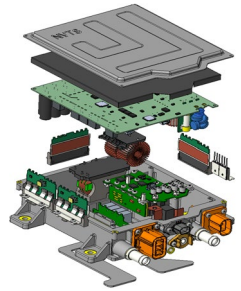


Semi Design

Application-specific GaN / SiC

Customer Co-Development

Joint Labs / Joint Development

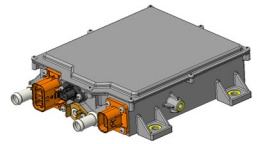


System know-how drives innovation

Close customer co-op for qualification, certifications, production readiness

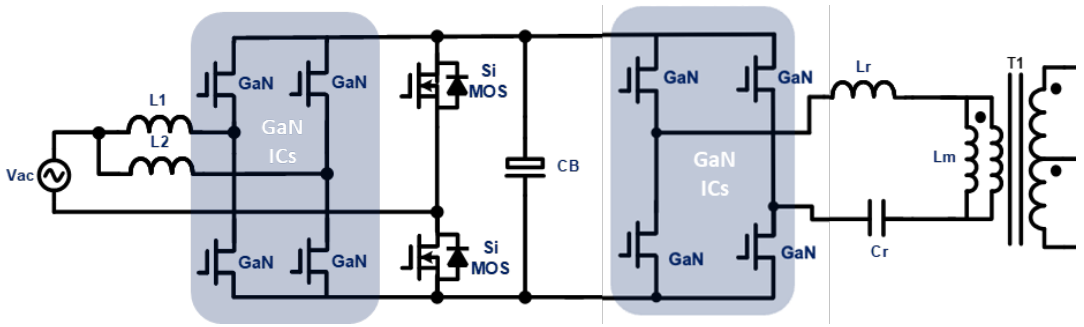
Mass Production

Fast time to market



NVTS 3.2 kW Sets New Density, Efficiency Levels

- Data center AC-DC 12 V high performance PSU
- CRPS185 form factor

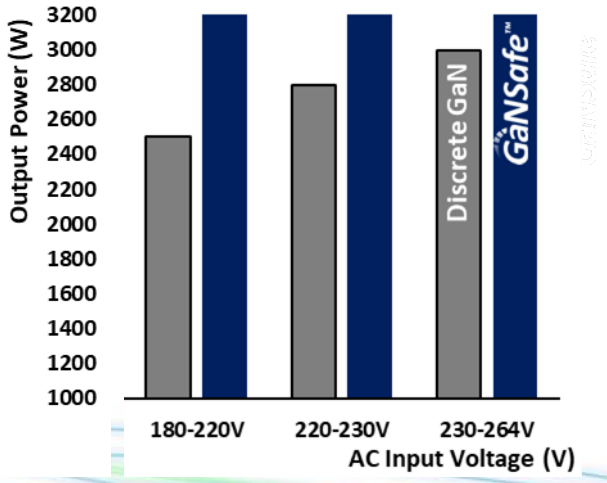


Power	3,000 W	3,200 W
PFC	8 x 32 mΩ GaN	4 x 60 mΩ SiC
DC-DC	4 x 32 mΩ GaN	4 x 45 mΩ GaN
Total	**12** x GaN*px*™ 	**8** x TOLL 

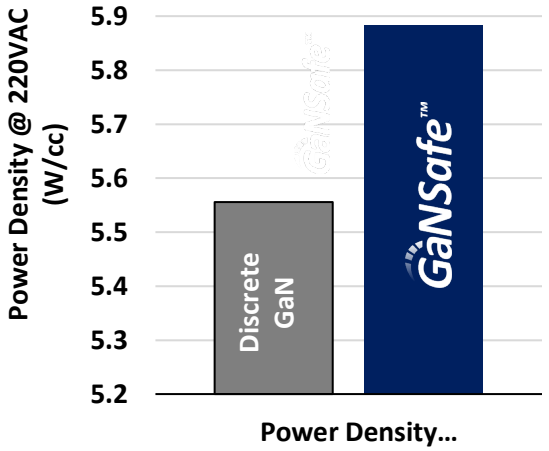
Navitas

33% fewer power components

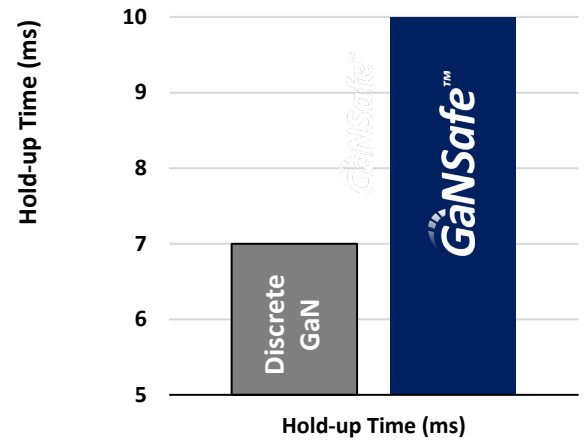
Navitas **True 3,200 W CRPS185**



Navitas **~100 W/in³**

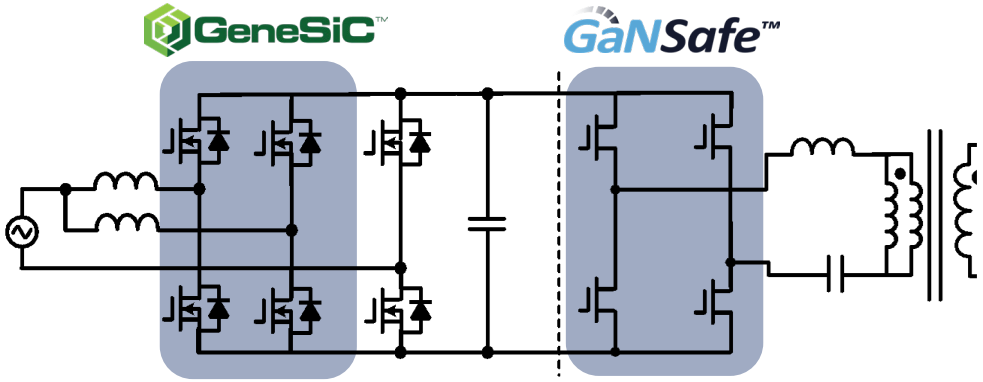


Navitas **+40% Hold-up**



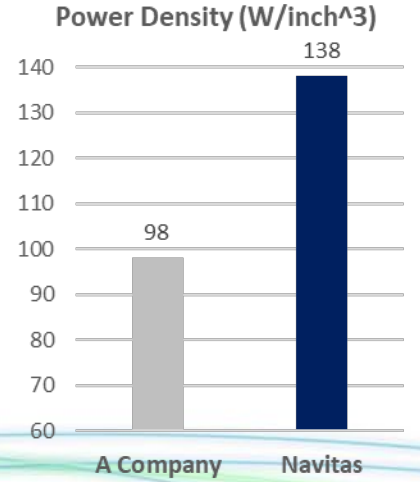
NVTS 4.5 kW AI Server Power

- Data center AC-DC 54 V AI/GPU Server PSU
- CRPS185 form factor

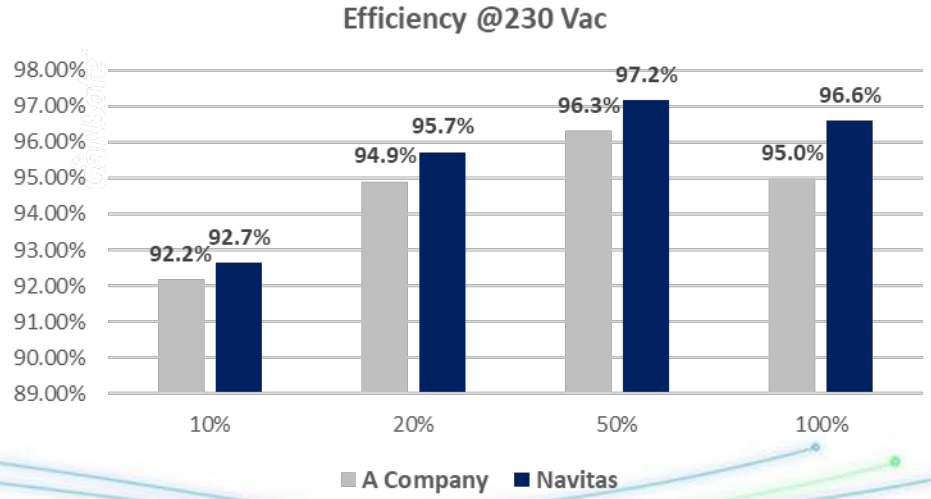


Company	A Company	Navitas
Power	3,200 W	4,500 W
DC-DC	<150 kHz Si/SiC	300 kHz GaN
PD	98 W/in^3	138 W/in^3
Eff	~96.3%	>97%

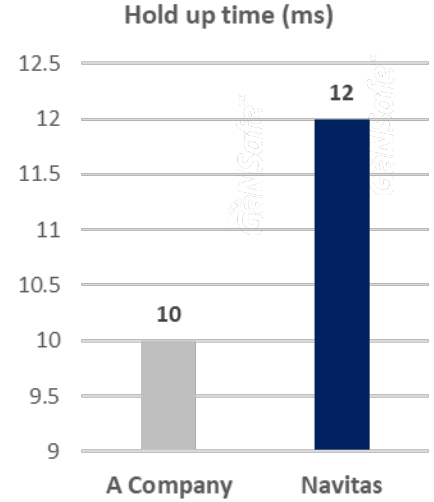
Navitas +40% Power Density



Navitas >97% Efficiency

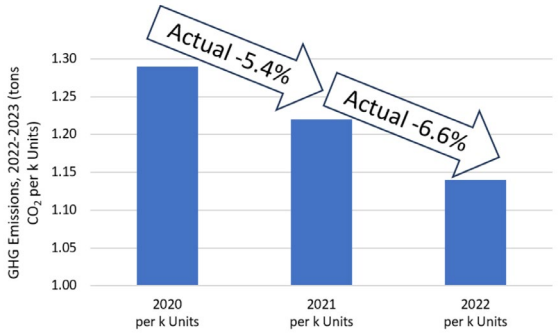


Navitas +20% Hold-up

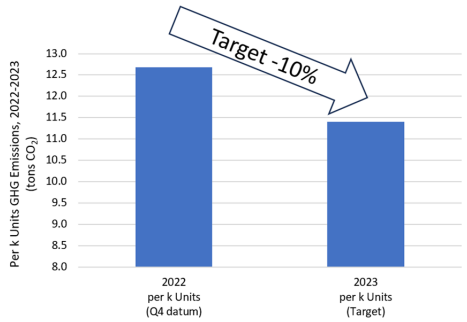


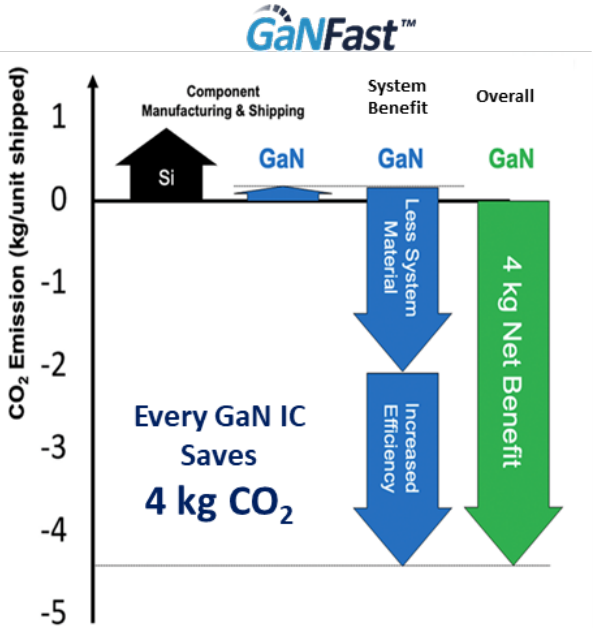
Accelerating Sustainability

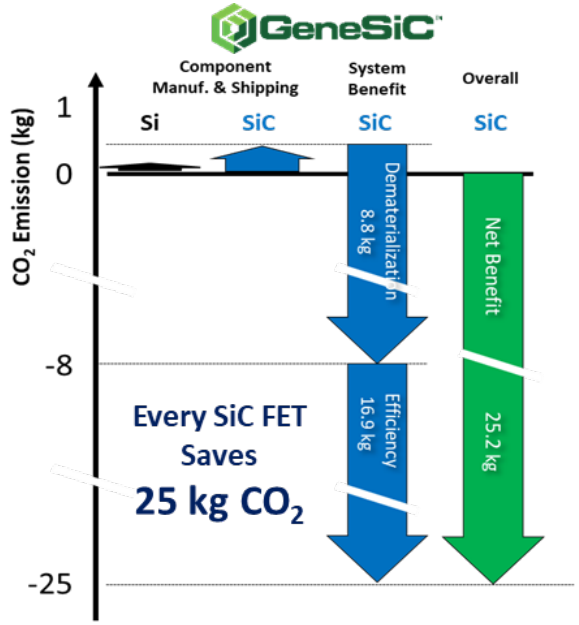
Navitas Corporate GHG Scope 2, 3 (GaN only)



Navitas Corporate GHG Scope 2, 3 (GaN + SiC)







Feb '22 World's first GaN Sustainability Report

May '22 World's first semiconductor Company certified CarbonNeutral®

Aug '22 First 100,000 tons CO_2 saved [Nov'23 over 200,000 tons]

Oct '22 Recognized as Industry-Leading Sustainability Company

Nov '23 Consolidated GaN + SiC Sustainability Report

tech Taipei
for top electronics engineers

Navitas Delivers AI Server Power: GaN & SiC Hybrid 4.5 kW

Kevin Wang
Sr Director Sales and Taiwan Country Manager

21st March 2024